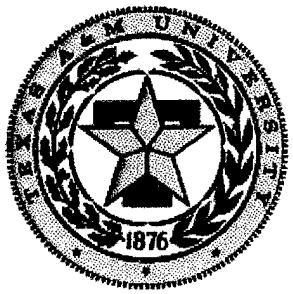
Challenges in the Management of Public Works Department Interactions

Master's of Engineering Report



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Abstract

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In the construction industry, Public Works Agencies provide the backbone for the maintenance and construction of the Nation's infrastructure. These Public Works Departments (PWD), State Highway Departments, and the Federal Highway Administration perform the vast majority of infrastructure project planning and management. In the course of performing their duties the PWD must coordinate with many different agencies and organizations. These organizations are from both the private and public sectors. The PWD Project Engineer or Project Manager, depending upon the title used the individual PWD, must interact with the various government agencies to obtain permits, grants, funding, project request, and prioritization of projects. Typically, the Project Engineer must also coordinate with the design consultants and construction contractors to complete the project cycle. As a result of these many interactions, debate, and disagreements will naturally occur. Conflict management can be a valuable concept for the Project Manager to increased awareness to potential conflicts and generation of different perspectives during the project management process. A Public Works Department can employ a host of interaction management tools to increase the effectiveness of the many interfaces. This report seeks to identify the various levels of interaction between a public works department and other participating agencies, as well as internal interaction and determine the many levels and causes of organizational

conflict for a public agency. Finally, the development of new management techniques or the use of existing management tools to manage and resolve conflict was evaluated. Partnering is a very common interaction management tool used by both public and private sectors. Other management tools include constructibility reviews and other organizational development concepts.

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Chapter 1: Introduction

Public Works Agencies are the backbone for the maintenance and construction of the nation's infrastructure. These organizations are commonly referred to as the Public Works Department (PWD). City, county, and state public works departments develop, plan, and execute the various programs and projects to operate and maintain the transportation, sanitation, and water supply systems for their respective level of government. A cooperative effort is required in many cases on large projects. These projects impact services or facilities that are under the jurisdiction of the different government levels, requiring a cooperative effort from the government offices to make decisions, develop budget plans, and assign responsibilities for projects. Other public agencies also become involved in the development and execution of the projects as well as numerous private organizations, such as consulting firms, legal firms, and construction firms. For these projects, the lines of responsibility for decision making and funding are not always clear. In these instances, the PWD must coordinate the project with the various public and private agencies to ensure that a viable facility is completed to support the intended purpose. Extensive agency interaction during the planning and execution of the projects often results in organizational conflict and debate between the various agencies. Each agency is very concerned about their interest in the project. This is where the benefits of the centralized PWD are valued to provide the project management responsibilities.

The organization breakdown of the PWDs varies greatly with each level of government. City and county public works department typically fall under the guidance of a Director of Public Works and contain the ability for engineering, construction, and

maintenance of the public services. The typical public services include transportation, water resources, solid waste management, and ground maintenance. Figure 1 illustrates the general framework for a typical city and county public works department. State agencies, in contrast, are not normally organized in the same manner. State maintenance agencies are not normally organized under a single public works director, but are organized by the function area. For instance, in Texas, the highway maintenance programs are under the control of the Texas Department of Transportation, while other maintenance areas are provided by different state departments as appropriate.

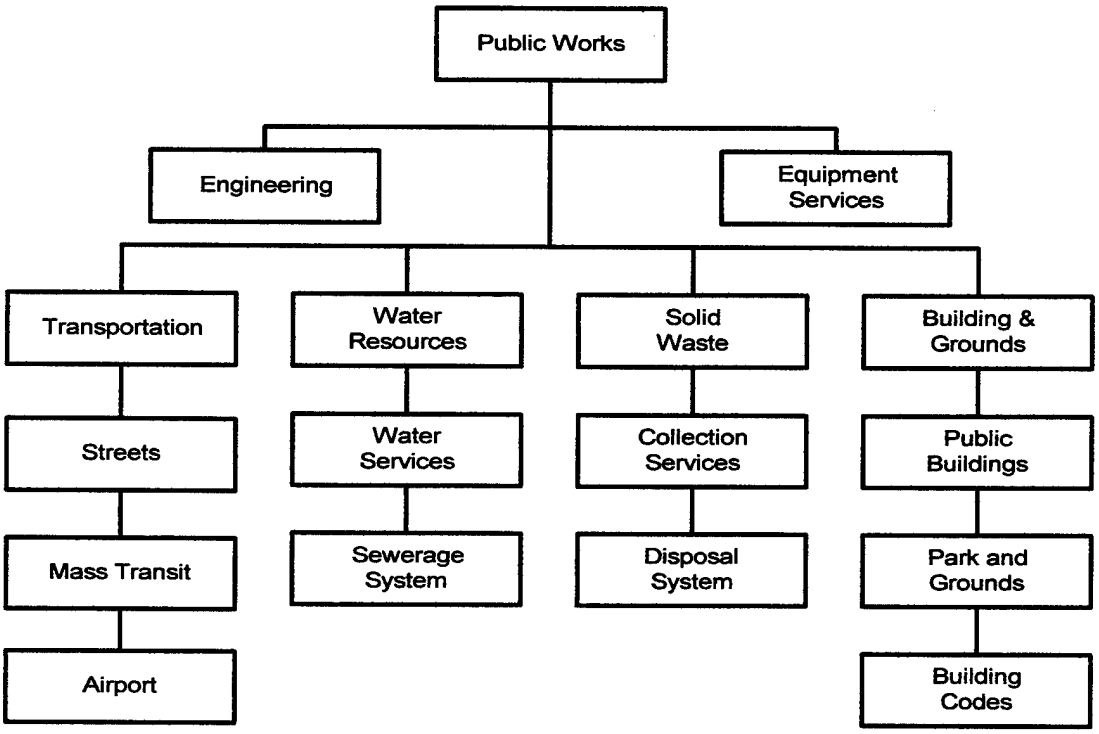

Figure 1: Typical Public Works Organization (*Local Public Works*, 1970)

The project management function can be located at several locations within the PWD. In the typical organization, as described in Figure 1, the project management

would probably be located with the Engineering Division. The Project Manager is the hub of the project planning and management processes at a Public Works Department (PWD). Daily interaction is required on the part of Project Managers to coordinate with other PWD divisions and any interested external agencies. The maintenance of the infrastructure system is crucial to the economic growth of an area and, therefore, significant interest is usually bestowed upon these projects by the public sector and other government officials. The management of these infrastructure projects is often controversial with high levels of conflict and public interaction. The project manager is responsible for managing all of these activities to achieve a costly, timely, and quality product.

1.1 Background

For this report, the project management activities of the Dallas County Public Works Department will be reviewed as a case study to establish project management interaction with other PWD divisions and external agencies. This report is based upon a case study performed by Dr. Stuart D. Anderson and Dr. W. Edward Back of Texas A&M University for an audit of the project management activities of the Dallas County Public Works Department. During the course of conducting the audit, Anderson and Back noted that there was a large number of interagency and external interfaces that the PWD's project managers were required to maintain. During the interviews the project managers talked about the large number of projects that they were responsible for and the number of meetings, conferences, and other forms of communication required for managing the projects. The contents of this case study were used to derive internal and external agency relationships in the performance of project management activities.

1.2 Purpose

The purpose of the report is to discuss and outline the project management interactions of a typical Public Works Department. Through this discussion, a better understanding of the quantity and frequency of both internal and external agency interactions can be determined. By reviewing these interactions an analysis can be conducted on how conflicts arise, and on the effectiveness of various methods to increase or decrease the level of the organizational conflict. Different management tools to resolve conflict can also be discussed and evaluated.

1.3 Objectives

To achieve the basic purpose of this report the following objectives were established:

1. Identify internal agency relationships and their relation to project management.
2. Identify any interactions with other public and private agencies or companies.
3. Relate the external interactions to project management requirements.
4. Identify any management tools used by a public works department to enhance the degree and success of interaction on the various projects.
5. Evaluate how conflicts arise, the benefits of conflict, and conflict management techniques.

1.4 Methodology

To accomplish the stated objectives, a literature review was conducted to determine the information available on the typical interactions of a public works department. First, an understanding of the typical PWD organization structure was

required. Then, issues related to PWD personnel interactions were compiled and assessed against the organization's internal and external interfaces. The case study by Anderson and Back on the Dallas County PWD was used to establish these relationships.

These issues were related to organizational conflict, which arises as a result of personal interactions, and management style or tools which can be used to enhance the working relationship between the PWD departments, and with external agencies. These issues were evaluated with regard to achieving effective relationships with other groups.

1.5 Outline

This section outlines the remainder of the report and provides the reader with the basic description and organization of a public works department. The purpose was also stated in the introduction as well as the report objectives. The following chapters will build upon these sections to achieve the stated objectives.

Chapter Two. A thorough literature review was conducted to obtain as much information on the organization, staffing, and interactions of a public works department. Information was also obtained on the causes of conflict, benefits of organizational conflict, and conflict management. Several article and books were reviewed that discuss the use of groups to determine the most appropriate decision for the pending issue. Interaction management tools were also researched to determine how to cope with project management relationships and resolution of conflict.

Chapter Three. The organizational structure of the Dallas County Public Works Department was obtained and reviewed. From this organizational chart and the case study by Anderson and Back, the intragroup interactions of PWD were determined and their impacts were noted. These interactions were identified to be either critical or non-

critical for the successful management of the projects. The Dallas County PWD has numerous interactions with both public and private organizations during the course of planning, designing, and constructing the various municipal projects. These interactions were compared with desired outcomes and project decisions making procedures.

Chapter Four. The management of group conflict has emerged as a powerful tool for public and private organization. This chapter develops the ideas that conflict is required for achieving improve performance in the market place. New ideas and challenges can be presented by using conflict development techniques as described in the chapter. Management styles to resolve and maintain the appropriate level of conflict were also discussed. The different sources and types of conflict were outlined with regard to a public works department.

Chapter Five. Several interaction management tools were discussed with regard to organization conflict management for a public works department. The use of partnering was discussed for both internal and external interaction. From this discussion four levels of partnering were established and the benefits of each were outlined. The benefits and purpose of the constructibility review were discussed with regards to interaction between agencies and within the PWD. Another management tool (Fabricated Organizational Structure) for managing public projects was also presented with its impact on resolving conflict.

Chapter Six. A general statement was completed summarizing the contents of the report. Here, the information flow of the report is summarized. First, the various organization interactions of a PWD were discussed in Chapter Three. Next, the sources

and levels of organizational conflict were outlined in Chapter Four. Then, in Chapter Five, the use of management tools to manage and resolve conflict were discussed.

Chapter Seven. A conclusion about the effectiveness and management of organizational conflict for a Public Works Department was determined. This conclusion outlines the interaction levels of the Dallas County Public Works Department, and also delineated some interaction management deficiencies within the Dallas County PWD. Five methods to improve PWD interactions were recommended.

Chapter 2: Literature Review

The outline in the previous chapter introduced the concept of the many interactions sustained by a public works agency in the performance of its duties. After reviewing many journal articles, books, abstracts, and browsing the Internet, an in-depth discussion of the various public works interactions and associated relationship issues can be presented. This chapter discusses the various literature used to meet the established objectives and formulate the discussion.

2.1 Case Study: Dallas County Public Works Department Audit

Anderson and Back (1997) performed an audit on the Dallas County Public Works Department (PWD). In the course of performing the audit they identified several internal and external relationships that were required for the organization to meets its mission. These relationships ranged from daily interactions to infrequent meetings to fulfill the various project management requirement. They determined that there were five basic areas of project management (PM) within a PWD. These are:

- Perform PM Activities during Planning
- Perform PM Activities during Pre-Design
- Perform PM Activities during Design
- Perform PM Activities during Construction
- Perform General Project Management

The audit concentrated on the first four areas which are directly related to project development and execution. The purpose of the audit was to evaluate, and make recommendations, on the project management effectiveness of the Dallas County PWD.

The audit was completed and presented to the Dallas County Commissioners Court in November 1997.

To evaluate the project management process, Anderson and Back used IDEF0 modeling techniques to identify the many function of project management. This modeling concept is very adept for evaluating the PM process. IDEF0 modeling illustrated the inputs, controls, and mechanisms which direct the function to produce an outcome. Figure 2 is a context diagram for the project management process. The diagram represents the entire project management process and illustrates the interfaces that occur with other entities or information provided by others.

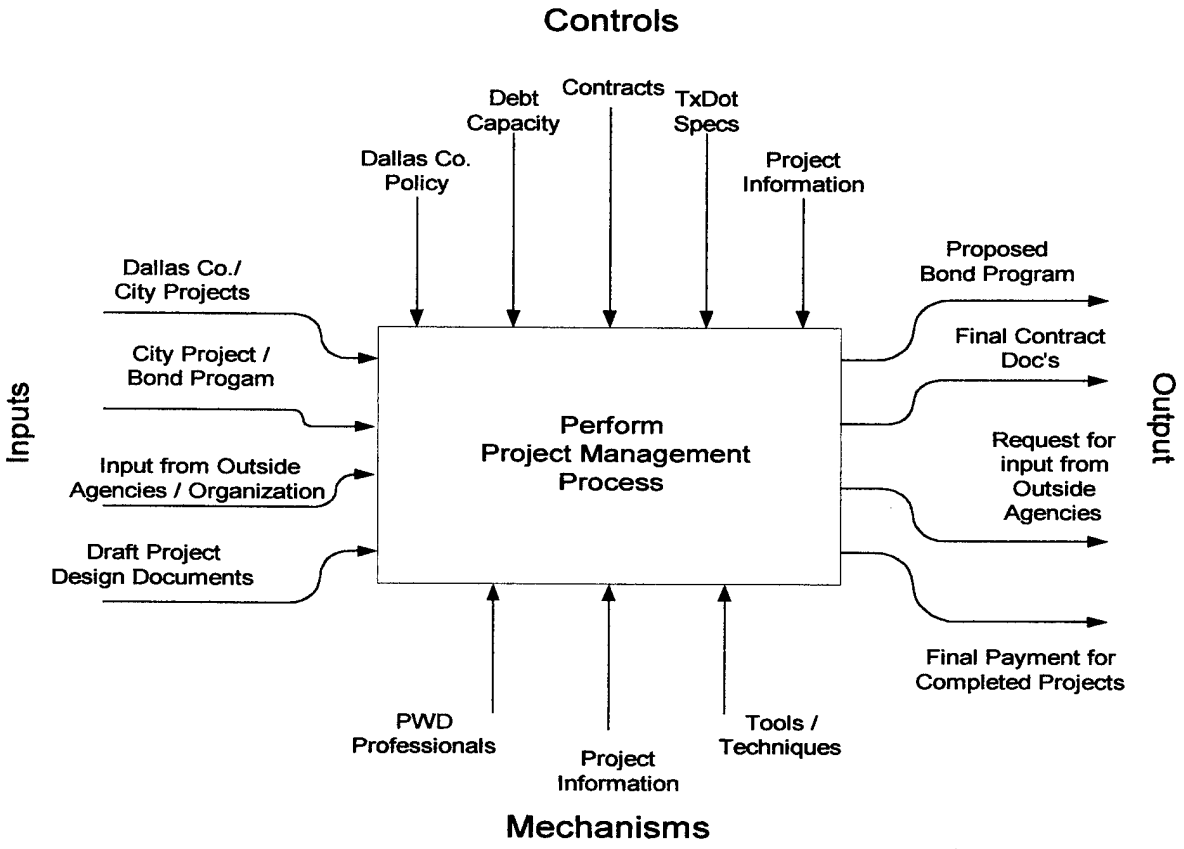

Figure 2: Context Diagram for Perform Project Management Process

The inputs into the model are representative of the city and county projects, input from other agencies and draft project documents. Mechanisms are the PWD professionals, outside agencies, and management tools/techniques. Some of the many project controls are contracts, project information, and debt capacity. Proposed bond program, contract document, and payment for completed projects are some of the outputs from the modeling procedure. All four of the interfaces (input, mechanisms, tools, and output) require extensive interactions with other public agencies, private consulting and construction firms, as well as internal relationships.

2.2 Conflict

Eisenhardt, Kahwajy, and Bourgeois (1998) explained that conflict in an organization or management group leads to consideration of more alternatives, better understanding of the choices, and overall, significantly more effective decision making. Their article established that, without conflict, a group losses effectiveness, becomes apathetic, and practices poor decision making. They address the issue by identifying four methods to increase conflict within the functional group. These methods are to build heterogeneous teams, create frequent interactions, cultivate distinct roles, and count on multiple-lens heuristics. The authors described these methods as levers to achieve conflict. Using these levers a group can increase their interaction and more actively debate differing viewpoints before making the final decision of the issue at hand.

To be able to monitor, and measure, the amount of conflict in an organization was addressed by Singh and Johnson (1998). They established that a measurement of the preferred method of conflict management should be determined for the organization. These conflict management methods were identified as forcing, problem solving, smooth,

complacency, and withdraw. Singh and Johnson also developed a method to rate the five different methods to determine the most preferred choice. They identified that there are intragroup conflicts and intergroup conflicts within any organization. The ability to measure the magnitude of these conflicts was determined to be best measured by a numerical score system. They identified for the reader seven project management related areas where intragroup and intergroup conflict should be measured. These areas were first developed by Thamhain and Wilemon (1975). These common project management sources of conflict are:

- project priorities,
- administrative procedures,
- technical opinions and performance trade-offs,
- budget resources,
- cost of project,
- schedules and manpower, and
- personality.

Singh and Johnson developed a scoring scale on a 0 – 4 scale to evaluate the conflict frequency and conflict intensity for the seven sources of conflict. They also believed that moderate to high conflict is essential for organizations to increase their effectiveness and decision making practices.

All of the articles reviewed agreed that conflict is not to be avoided, but encouraged in the organization. Allowing improved decision-making, generation of more points of view, and development of new ideas.

2.3 Interaction Management Methods

Partnering is a well-known management tool used by groups to form common goals and objectives before proceeding with a project. According to the Construction Industry Institute (*In Search,* 1991), partnering is

> "A long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organizational boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each others individual expectations and values."

Partnering has become a common tool used by the public sector in the management of construction projects. The U.S. Army Corps of Engineers has long since been a leader in the public sector's partnering movement (Rock 1992). They have developed and promoted the partnering program to suit their needs on construction projects with exceptional results. In keeping with these results, the partnering concept can be adopted by a public works department to increase timeliness of projects, reduce cost, and reduce litigation.

The partnering process was modeled by Anderson and Back (1997) during their audit of the Dallas County Public Works Department. They identified four functional activities that were involved in the process. The key participates in the model were PWD project engineer, contractor, and city representatives. The four actives identified were (1) Prepare for partnering workshop, (2) Notify participants, (3) Select Facilitator, and (4)

Conduct partnering workshop. According to Rock (1992) the workshop is a critical stage in the partnering process and was used to initiate the owner-contractor relationship 85% of the time. As a result of the partnering workshop a partnering agreement is completed and signed by all participants. (See Process Diagram 16 in Appendix A for the partnering process of the Dallas County Public Works Department.)

The use of partnering has provided much success for public works agencies. One such instance is the construction of the Central Artery/Tunnel project in Boston, Massachusetts. In this huge project ($ 7.78 billion in 1994 dollars), the Massachusetts Highway Department (MHD) implemented the partnering process in 1992 to find ways to meet tight schedules, keep cost down, and minimize litigation (Daigle & Touran 1998). At this site a portion of the projects employed the partnering process, while others did not. Daigle and Touran (1998) evaluated the effectiveness of the partnering process. They found that partnered projects outperformed the non-partnered projects in cost growth, schedule growth, change order volume, and value engineering savings. From these results, it is easy to see the benefits for a PWD to employ partnering to improve the performance of their construction projects.

To further understand the implications of partnering, Thompson and Sanders (1998) developed the Partnering Continuum. This summarized that there were four general categories of project relationships. There are:

- competition,
- cooperation,
- collaboration, and
- coalescence.

This report compared the potential benefits of partnering to the degree of objective alignment. Characteristics and benefits for each of the four general categories were outlined and discussed in the article.

Since one of the primary objectives of partnering is to continually improve overall performance on the project (Hancher 1991), some type of performance evaluation of the partnering relationship should be part of the arrangement. The means to measure the effectiveness of partnering was addressed by Crane, Felder, Thompson, Thompson, and Sanders (1999). They surmised that the effectiveness of partnering must be measured to promote proactive involvement and advance notice of potential problem areas. They proposed one method of measuring the success of partnering was to use a "Objectives, Goals, Strategies, and Measures" method. This method identified a primary objective, then established intermediate goals to achieve the objective. A set of strategies was then developed to support the established goals. Measures were designed to assess the progress towards the implementation of the strategy. They also established that there were three levels of measurement: Result; Process; and Relationship. By evaluating all three of these levels the partnering participants can evaluate the effectiveness of the partnering team, the efficiency of the activities, and forecast potential problem areas.

Anderson, Fisher, and Rahman (1999) stated that transportation agencies recognize the need for contract documents that will ensure rational bids and minimize problems during the construction of facilities. To obtain these improved contract documents, constructibility reviews may be performed. The constructibility review is another method of initiating the relationship between various parties. Anderson, Fisher, and Gupta (1995) termed constructibility as the integration of construction knowledge,

resources, technology, and experience into the engineering and design of a project. This obviously involved multiple personnel from within and external to the agency initiating the constructibility review. This process can play vital role in the establishment of organizational interacts and improved communication between project participants.

It is not unusual for large public projects to be highly controversial (Wakeman 1997). The controversy is frequently centered on public of the project instead of the technical aspects of the project. In light of this, "new" management concepts need to be developed for the Project Engineer to support the goals of the projects. Wakeman presented the idea of an organization whose primary focus was to assist decision-makers resolve conflict and make choices on construction projects. The "engineers" would provide technical and financial assistance. In the end this process is not very different for partnering, but initiates from a different viewpoint.

2.4 Summary

The literature discussed in this chapter, assisted the author in developing the basic interfaces sustained at a public works department. The literature by the American Public Works Association discussed the various types of PWD organizations and established a "typical" city/county PWD organization. The case study by Anderson and Back outlined the actual interfaces for the Dallas County PWD. The development, management, monitoring, and resolution of organizational conflict was outlined and discussed with regard to a public works department. The use of interaction management tools to assist the project engineer, designer, and/or public officials make decision and recommendation on the construction projects were reviewed and outlined in this chapter.

Chapter 3: Dallas County PWD Interactions

The Dallas County Public Works Department will be used as a model, in this chapter of the report, to outline and discuss the many interactions within the PWD between the various divisions and their interfaces with external agencies or companies. The information on the Dallas County PWD was obtained from the case study performed by Back and Anderson (1997). The case study was conducted as an audit of the project management activities of the PWD at the direction of the Dallas County Commissioner Court. Therefore, the interactions discussed in this chapter will be related to the development and management of construction projects. The public works department's organizational structure, and project management process, will be reviewed to establish the framework for the discussion on the intragroup and intergroup relationships of the public works department.

3.1 PWD Organization

To identify the many PWD interfaces, it is important to first review the PWD's organizational structure. The Dallas County Public Works Department is headed by a PWD Director. There are four major divisions within the Dallas County PWD. These are Administrative Services, Transportation/Planning, Property, and Engineering/ Construction. Each of these divisions reports directly to the Director.

Within each division there are several functional sub-divisions. These sub-divisions are shown on the Dallas County PWD organization chart in Figure 3. The Administrative Services division provides the administrative assistance to the Director and other divisions for PWD operations. The Transportation/Planning division is composed of the Transportation Planners, Traffic Engineer, and Automation Manager.

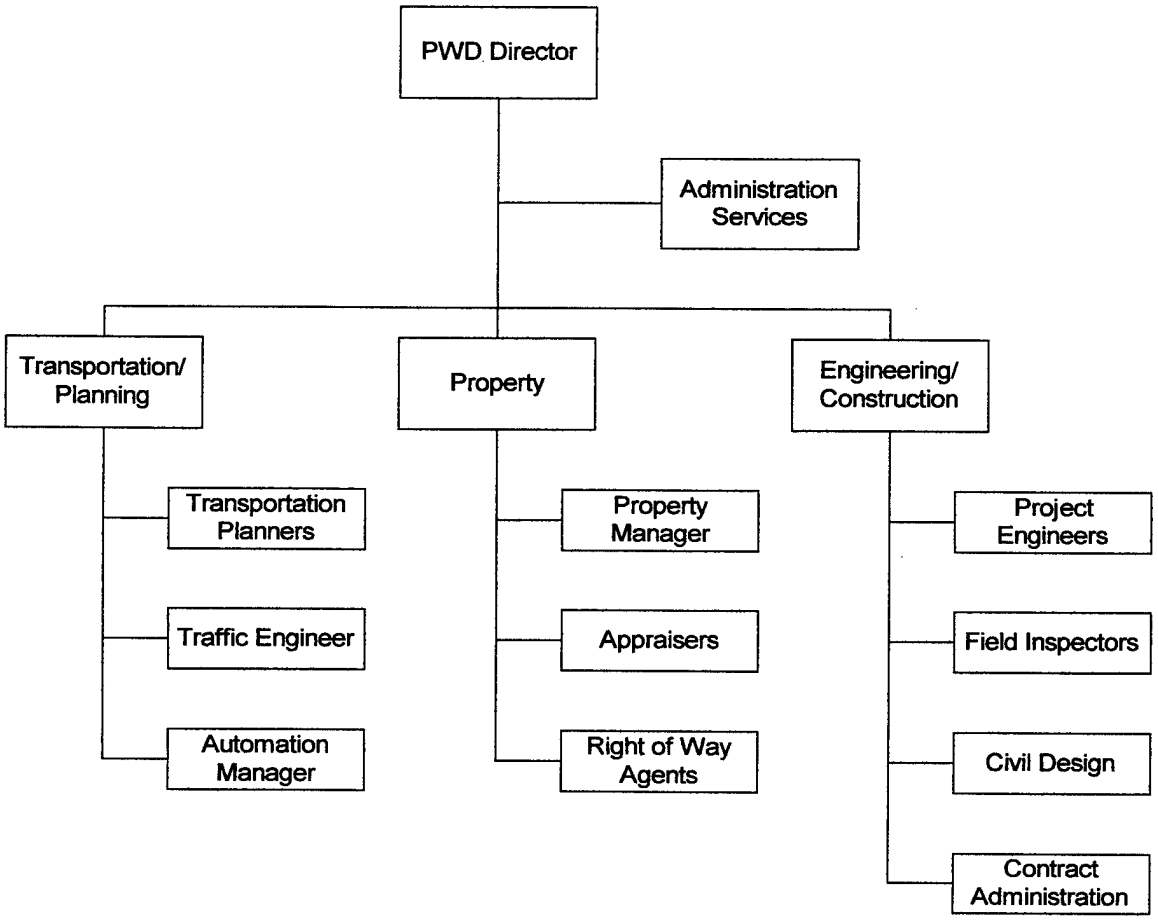

Figure 3: Organization Chart for Dallas County Public Works Department

These areas are concerned with the study of traffic related problems in Dallas County and the development of maintenance or construction projects to alleviate the deficiencies. The Property division is made up of Property Managers, Property Appraisers, and Right of Way Agents. These personnel manage and develop the programs to manage right of ways for projects, mediate problems associated with county property, coordinate with franchise utilities on right of ways, and provide cost estimates on purchase of additional land requirements. The Engineering/Construction division is the largest of the four divisions and is comprised of the Field Inspectors, Project Engineers, Contract

Administration, and Civil Design Section. The Civil Design Section includes Design Drafters, Design Engineers, Engineering Technicians, and Field Surveyors. In this division the "nuts and bolts" of project management is performed. The Project Engineer and Design Engineer manage the project design and coordination with consultants. The construction process is monitored by both the Project Engineer and the field inspectors.

To study the various interfaces associated with project management of the many construction projects, the E/C division must first be reviewed. This is where the project engineers are assigned who will provide the oversight and coordination efforts for the project.

3.2 Project Management Process

The project management process needs to be outlined. The case study by Anderson and Back established that four stages exist in the project management process. The project management (PM) activities originate in the planning stage then transcends through the pre-design and design stages before completion in the construction stage. Figure 4 illustrates the four stages and their subordinate activities.

The project management stages were further broken down into sub-stages. To facilitate this process, Anderson and Back modeled the project management process using IDEF0 modeling techniques. Twenty process diagrams were generated detailing the project management processes through the four stages. The process diagrams are attached to this report as Appendix A.

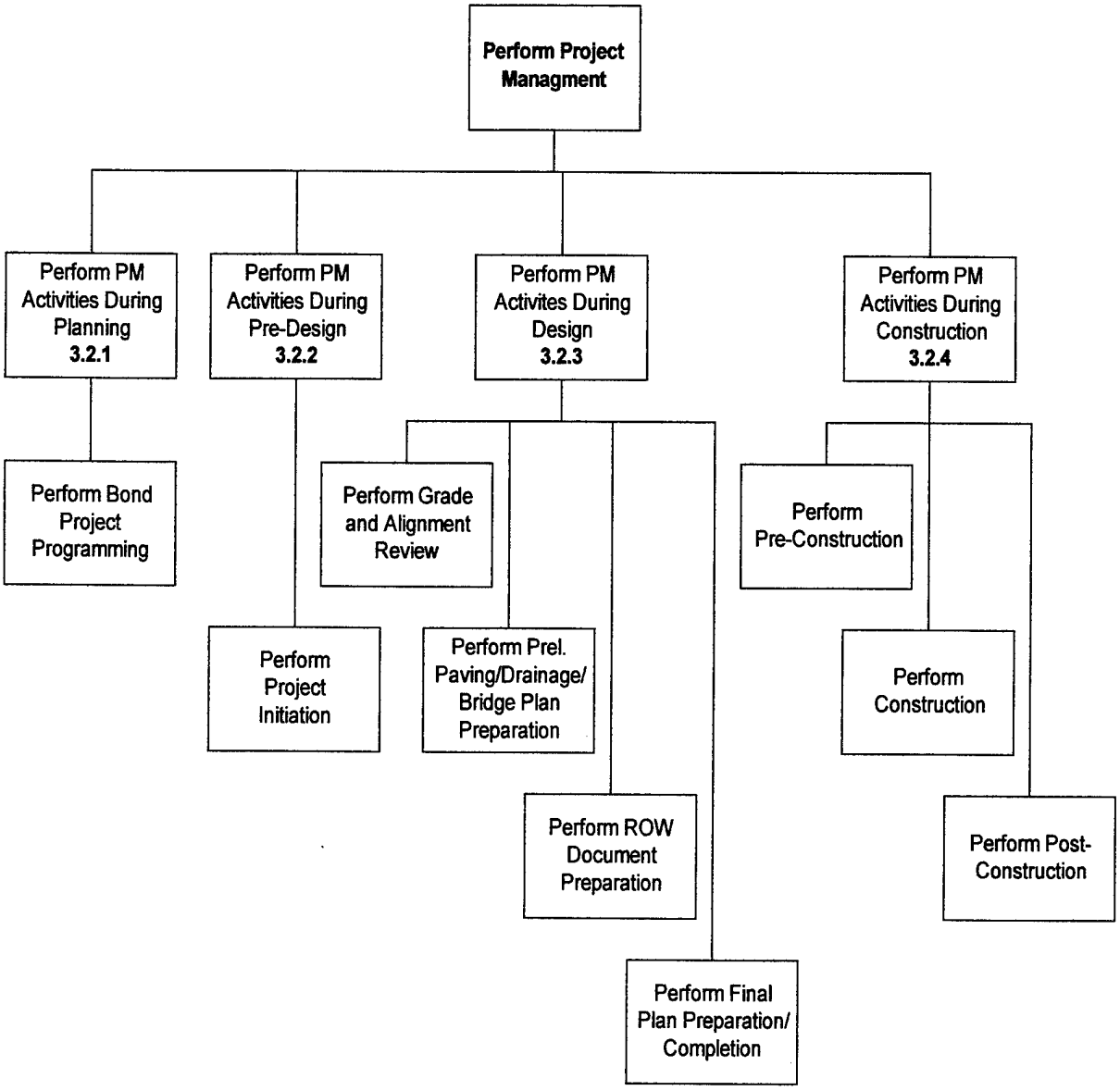

Figure 4: Four Stages of Performing Project Management

3.2.1 Planning Stage

In the planning stage, the bond program for the project is developed. This process involves the input from Dallas County and the cities within the county on potential projects. Project definitions and cost estimates are prepared and sent to the North Central Texas Council of Government for technical scoring. A priority rating is returned and

selected projects are submitted for the bond program. Process Diagram 3 in Appendix A outlines the project management planning stage.

3.2.2 Pre-Design Stage

The Pre-design stage is where the project is identified. Project definition is confirmed and a Project Engineer is assigned in this stage. The selection of the design consultant process is also initiated during this stage. The project scope document is completed prior to executing the design contract. Process Diagram 4 (also in Appendix A) models the pre-design activities. Many interfaces are established in this phase of the project.

3.2.3 Design Stage

The next stage in the life of a construction project at the Dallas County PWD is the Design Stage. This stage is comprised of four sections and they are:

- Grade and Alignment Plan Preparation,
- Preliminary Paving/Drainage/Bridge Plan Preparation,
- ROW Document Preparation, and
- Final Plan Preparation/Completion.

At this point in the project management process the Project Engineer has the lead on most activities. The Project Engineer coordinates with the other agencies to complete the design process of the project. Coordination with design consultants, cities, and other external agencies is also critical in this stage. During the Design Stage, the various plans are prepared and approved prior to construction. As the final activity in this stage the

project bid documents are prepared and the bid is advertised. These activities are identified and detailed in Process Diagrams 5 through 13 in Appendix A.

3.2.4 Construction Stage

The final stage in the project management process is construction. There are three stages of construction: pre-construction, construction, and post-construction. This phase begins after the project has been advertised for bid. Process Diagrams 14 through 20 illustrate the many activities of the construction stages. The administration of the construction contract, review and approval of submittals, and construction inspections are all typical activities in the project construction stages. Status reports to the Director and the customers on the project's progress are a common event in the construction phase.

3.3 PWD Interfaces

Now that the reader has been introduced to the organization and the four stages of project management for the Dallas County Public Works Department, the many interfaces during the project management process can be determined and discussed. The various relationships will be classified as either Internal Interactions or External Interactions. Figure 5 illustrates the many relationships between the divisions of the public works department and between PWD and outside agencies or companies. This report discusses these relationships as they occur during the four stages of project management. The diagram will be broken down in the following sections to further discuss the different relationships and what are the desired outcomes from the relationships. The lines in Figure 5 represent the different levels of interaction of a PWD.

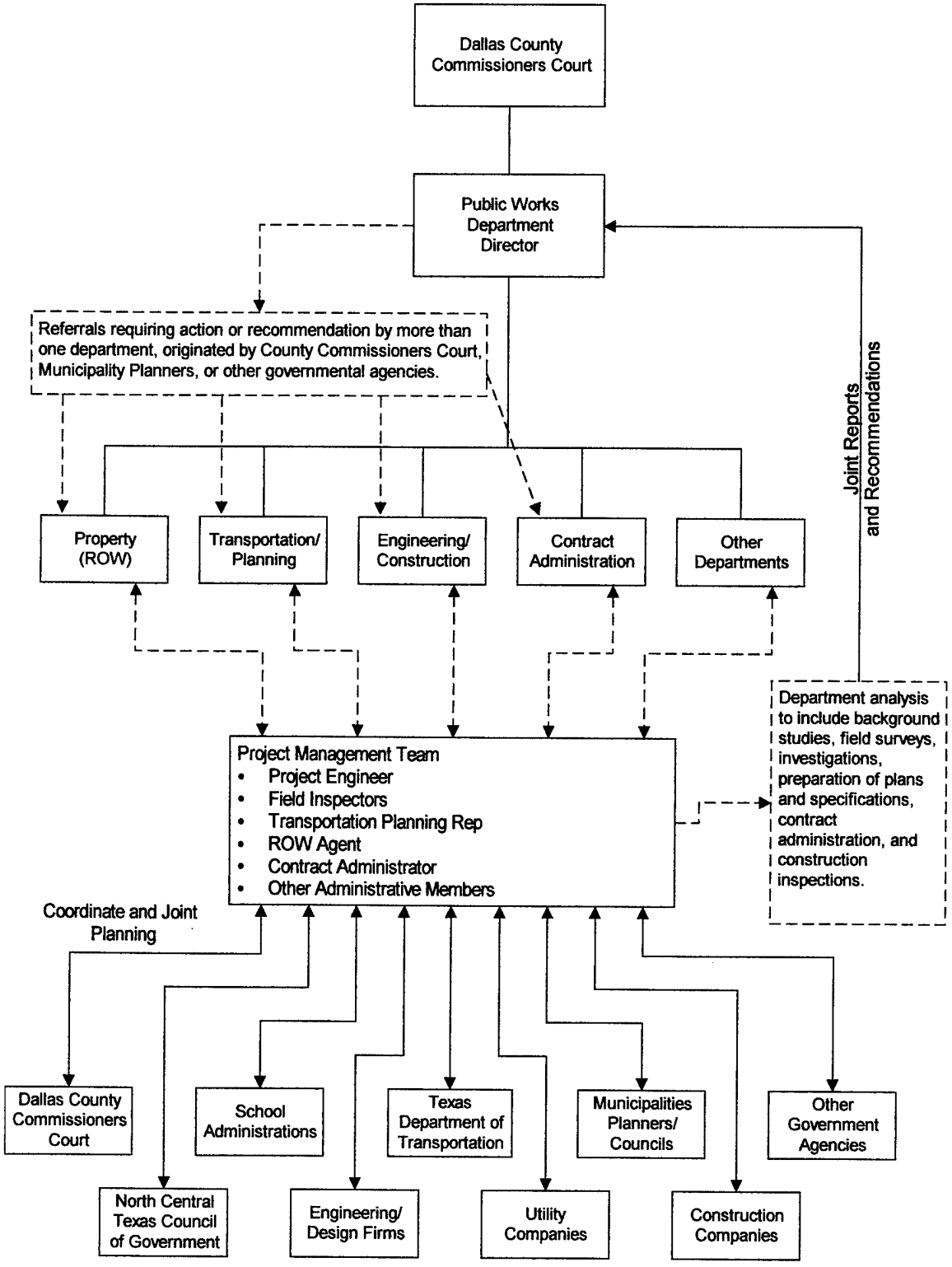

Figure 5: Public Works Department Interactions

The solid lines represent lines of authority (contracts, supervisor), while the dashed lines illustrate lateral interface within the PWD. It is important to note that the lines of interaction traverse in both directions, to signify the passage of information and interface between the parties.

3.4 Internal Interactions

The internal interactions are those between the divisions of the Dallas County Public Works Department. These interactions are required for the PWD to fulfill its mission in providing engineering and construction support to Dallas County and the associated cities and municipalities. Figure 6 has isolated the internal interfaces of the public works department. The Project Engineer is more often than not the central figure in these relationships. The Project Engineer coordinates within his/her division with the other Engineering/Construction sub-divisions, as well as the other three PWD divisions to monitor and track the various project management activities through the pre-design, design, and construction stages of the project. The following sections will summarize and discuss the interagency relationships for the project management stages. To facilitate this process, one activity was selected for each stage to fully show the input, PWD interface, and output from the activity for each stage of project management. An IDEF0 style model will be used to show these relationships.

3.4.1 Planning Stage

During the planning stage the divisions of the public works department are involved with process of defining, estimating, and prioritizing potential projects for the bond program. The internal interfaces in this phase are primarily centered on the Transportation/Planning Division. The PWD Director and Assistant Director for

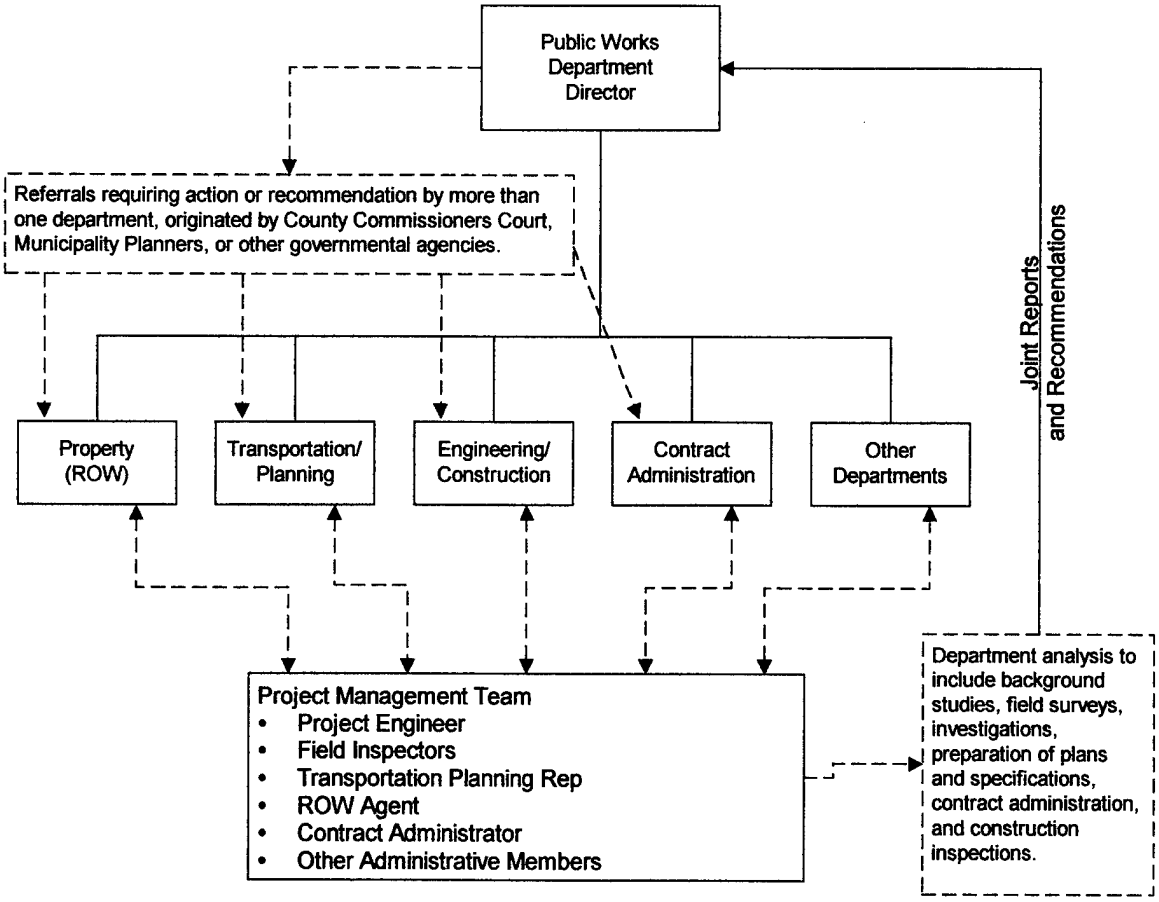

Figure 6: Internal PWD Interactions

Transportation Planning work together to obtain the request for projects from the county and local cities. After a project has been requested the PWD is responsible for developing the project definition. Here, the Transportation Planners and Assistant Director for Engineering/Construction collaborate to complete project definition. The completion of the project cost estimate is next with an assortment of PWD personnel contributing. As shown in Figure 7, the combined efforts of numerous personnel are required to prepare the project cost estimate. Their interface in this process is governed by the availability, accuracy, and timeliness of the stated inputs to achieve the project cost.

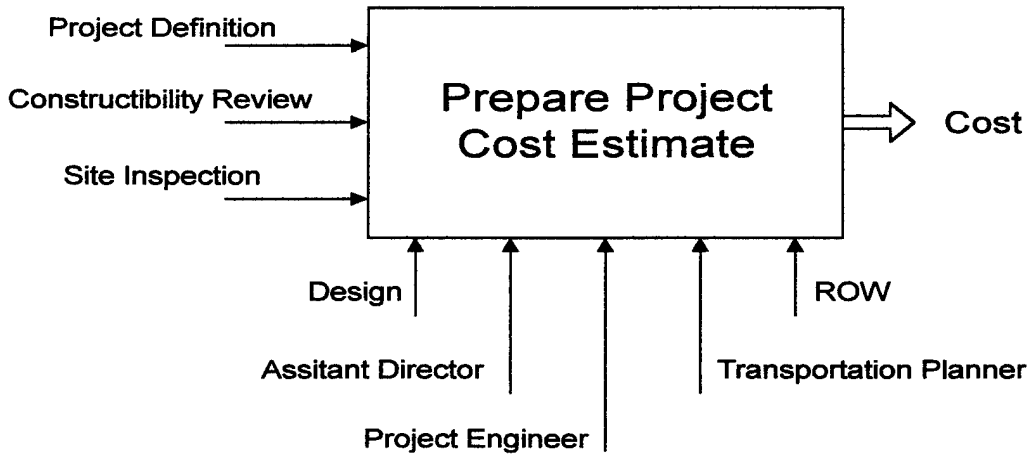

Figure 7: Project Planning Activity with Intragroup Interaction

3.4.2 Pre-Design Stage

During the pre-design stage the PWD personnel are striving to identify the project, complete the project scope, and hire a design consultant. The Project Engineer is assigned during this stage. He/she becomes the hub for the project activities. The PWD personnel employed during this stage are typical of the management and financial divisions. Once this stage is complete, and the design stage begins, the interface between the design, transportation planning, and property division will increase dramatically. Several project management activities were identified for this stage (Process Diagram 4 in Appendix A). Figure 8 represents one of these project management activities (Confirm Project Definition). In this activity the Director, Assistant Director and Transportation Planners must meet and coordinate their efforts to utilize the scope and location information contained in the Bond Program to develop the project definition and preliminary scope for the project.

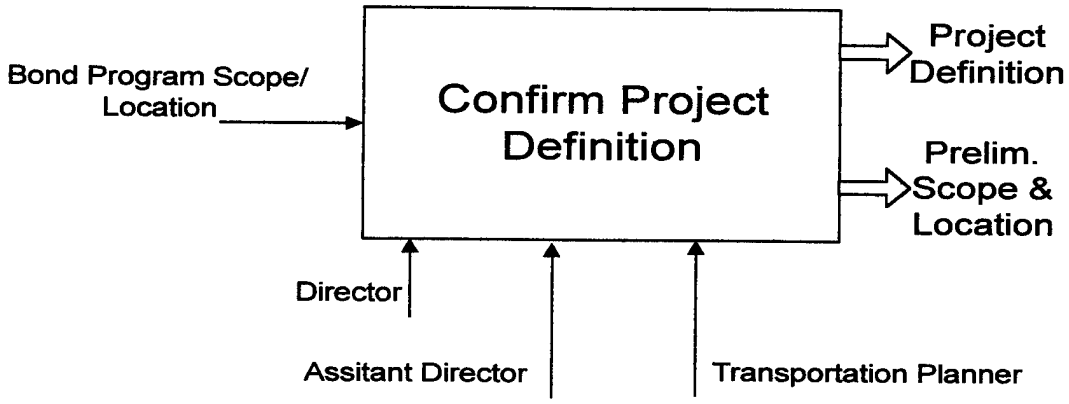

Figure 8: Project Pre-Design Activity with Intragroup Interaction

3.4.3 Design Stage

A pre-design conference is conducted at the start of the design stage of a project. This conference is used to establish the lines of commination with external agencies involved in the project, and to reaffirm the relationships of the PWD division. These conferences usually draw a large number of personnel and this is the Project Engineer's best change to address the entire project team at one time. The design consultant has now been selected, so the Project Engineer, and the PWD's design section, are in constant contact with each other concerning the consultant and their progress and quality. While the Project Engineer is responsible for monitoring the consultant's progress, the design section is concerned with the accuracy and timeliness of the preliminary plans and drawings. There are several sets of preliminary plans to be reviewed and approved by the PWD. These reviews require the attention of most of the divisions of the PWD. Figure 9 is a representation of a standard review activity. Some reviews do not require all of the personnel listed, but each of the participants is required to assist at some stage of the project documents review.

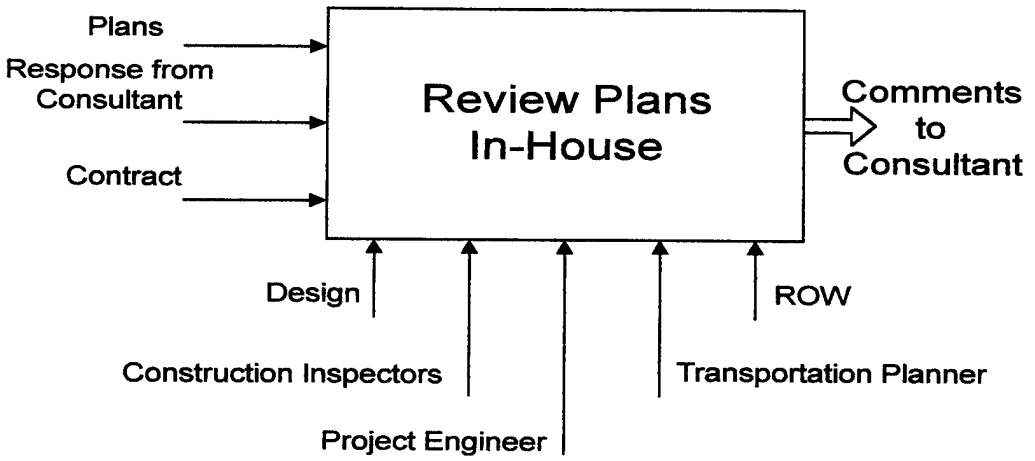

Figure 9: Project Design Activity with Intragroup Interaction

3.4.4 Construction Stage

In the construction phase of the project management cycle, the emphasis is shifted away from the design and transportation planners in the PWD to the field inspectors and contract administrators. The Project Engineer remains the central figure of the management effort and must closely coordinate with the Contract Administrator to complete the bidding procedures for the project. After the contract agreement is approved, the Project Engineer must interface with the other PWD divisions to establish the framework for the upcoming partnering workshop, pre-construction conference, and selection of testing agency for the project.

Meeting with the Field Inspectors becomes routine as the construction on the project begins and daily inspects are performed. The Project Engineer and Field Inspector(s) must communicate to ensure that the contractor is performing within specified standards. As change orders occur, the Project Engineer and Contract Administrator must prepare the contract modifications for the Director's review. As work progresses, a request for payment must be verified and approved. The Project

Engineer and Field Inspector(s) will review the request for payment and verify the quantities to the amounts in the Daily Inspector Reports. The Contract Administrator is also involved in the payment request process. Figure 10 illustrates the "Prepare Payment Request" activity.

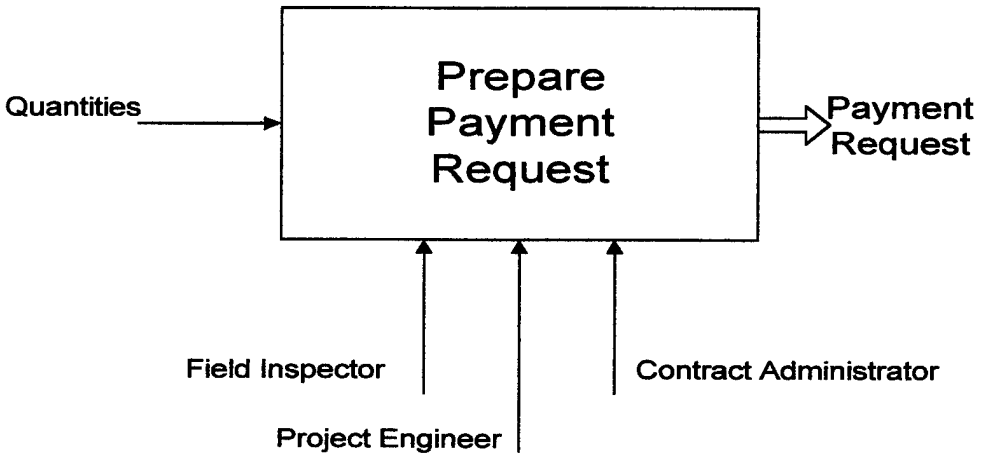

Figure 10: Project Construction Activity with Intragroup Interaction

Finally, as the construction project nears completion, the Project Engineer, Field Inspector(s), and Contract Administrator interact during the course of several project management activities. The final inspection, verification of remedial work, and final progress report and payment all require extensive coordination by the PWD personnel to ensure that the final stages of the project are executed smoothly. The design personnel also get involved during this time period to coordinate with the Project Engineer and Field Inspector to ensure the accurate completion of the "As-builts" for the project.

3.4.5 Summary of Internal Interactions

During the project management of a construction project there are many critical interactions between the PWD personnel. Many Project Engineers are not just

responsible for one project, but may have as many as thirty such projects. Due to limited time and resources, the Project Engineer relies heavily upon the field inspectors to be his/her "eyes in the field" and upon the contract administrator to ensure legality of the contract documents. Although the Project Engineer coordinates daily with other PWD official, the bulk of the his/her day is spent dealing with agencies outside the public works department. These external interactions will be discussed in the following section of the report.

3.5 External Interactions

As stated in the paragraph above, the majority of the Project Manager's coordination efforts most likely occur with outside agencies. Figure 11 shows the organizational relationship between the public works project management team to the outside agencies. These agencies are both private and public organizations. The private organizations are design consultants, construction companies, franchise utilities, and material testing agencies. Some public agencies include municipalities, Texas Department of Transportation, and Dallas County Commissioners Courts.

Within the public works department, all personnel are basically working toward a common interest and goal (completion of the project on time/ on budget/ with quality/ safely). This primarily due to the fact that all personnel within the PWD work directly or indirectly for the Director, and his/her goals and expectation are expressed throughout the PWD. This can lead to reduced conflict and disagreements in regard to the project management. This is not true for interactions with outside agencies. These agencies have their own business objectives and project expectations. Each project involves multiple outside agencies and their objectives almost never align. The

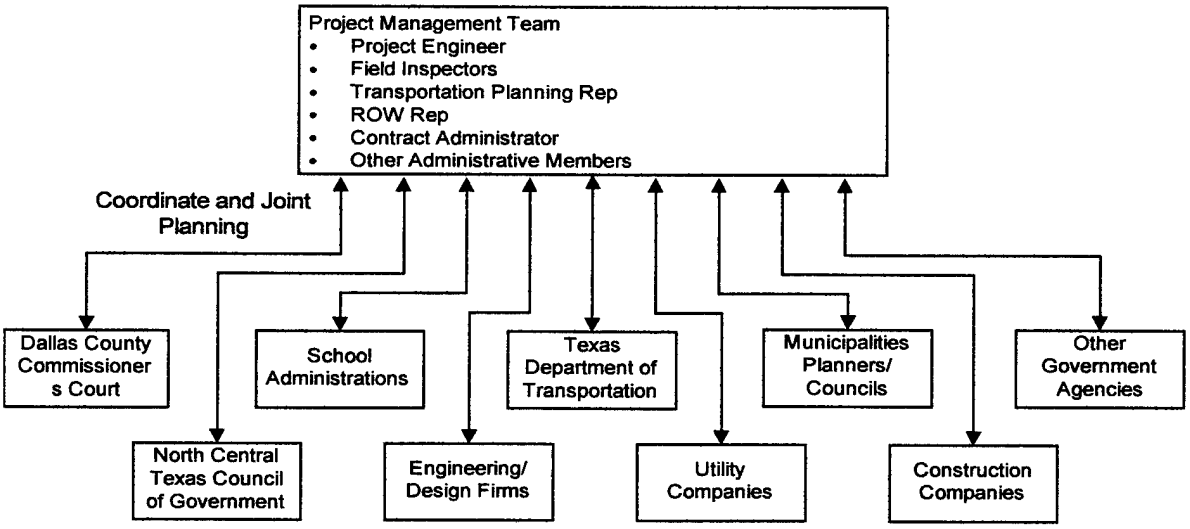

Figure 11: External PWD Interactions

successful Project Engineer is able to identify the various agency goals and objectives, and develop a plan to satisfy the different agencies as much as possible. The majority of the interaction between the PWD and outside agencies is divided among three organizations: Municipalities, Design Consultants, Franchise Utilities, and Construction Companies. The following paragraphs will seek to review the interactions with these four organizations.

3.5.1 Interface with Municipalities

Dallas County municipalities commonly employ the Dallas County Public Works Department to perform the project management on their transportation projects. In these relationships the PWD is expected to take a strong leadership role in the planning, design, and execution of the project. This relationship is extremely beneficial to the municipalities; they undoubtedly save time and money by not having to provide the project management oversight. The coordination of these projects is very dynamic. The

PWD Project Engineer and project management team must coordinate with all municipalities involved as well as many other agencies, such as schools, contractors, and regulatory agencies.

The two entities are bound by a City/County Agreement, which results in the dual reporting requirement for the PWD project management team. The Project Engineer must maintain the project reporting system of the PWD and become familiar with the reporting systems of the various cities. This places a substantial management burden on the project engineer.

Trust must be established between the two agencies. The Project Engineer is depending upon information provided by the city to develop the project definition and scope, and the city is expecting the PWD to provide a timely, quality, and cost effective product. The PWD is entrusted to conduct daily inspections, perform design work, and constructibility reviews to ensure the success of the projects. The process diagrams in Appendix A can be reviewed to obtain a better understanding of the roles and responsibilities of each agency. To summarize these aspects, Figure 12 was developed. Figure 12 illustrated the basic inputs on the left by each of the agencies, how the agencies interact, and the desired outputs on the right of the diagram. The basic inputs for the PWD in this interface includes project leadership, contracting ability, and technical abilities, while the municipality provides the project request and some funding resources. The two agencies interact in accordance with a City/County Agreement, which spells out the terms of the relationship. The output from this interface is defined project scope, prioritized project list, and progress payments to contractors and consultants. The

municipalities should participate in the PWD's project partnering workshops and sessions to assist in setting common objectives and goals for the project.

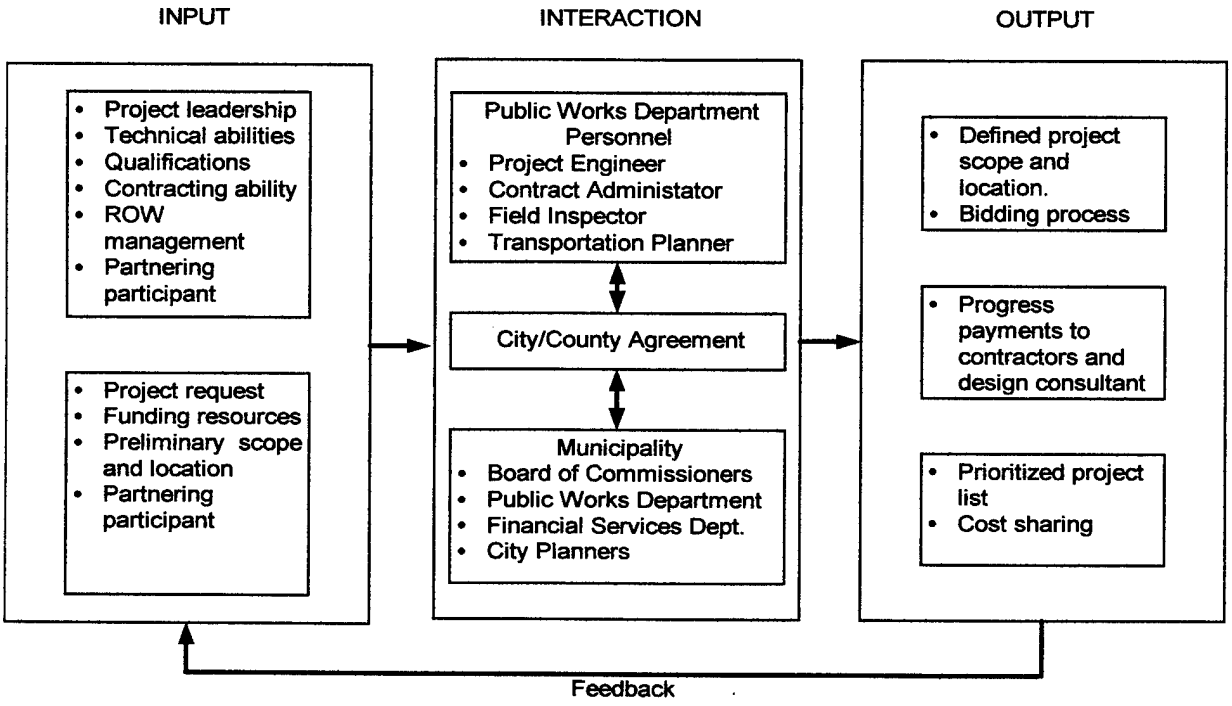

Figure 12: PWD interface with Municipality

3.5.2 Interface with Construction Contractor

The importance of interaction between the PWD and the contractor is very high. This is the basic interface for the execution of the project. Effective management of the project is crucial for success. Weak or inconsistent leadership on the part of the PWD Project Engineer would be disastrous. Delays, cost overruns, and escalating scope are common symptoms of weak leadership.

The classic relationship between the public works department and the contractor of "you build, we inspect" is not enough to guarantee success. Adversarial relationships

can quickly erode any teamwork established. The establishment of a partnering relationship is extremely beneficial, but many contractors are reluctant to enter into such agreements. Due to the fact that most PWD projects are contracted through the traditional bidding process with the award going to the lowest bidder, the contractor has little incentive to participate in the partnering process. If embraced, the partnering process will allow the PWD and the contractor to set common objectives and goals for the completion of the project.

The PWD's and contractor's roles can be identified from the project management activities developed by Anderson and Back (1997). By reviewing Process Diagrams 14 through 20 in Appendix A, the reader can see the extensive interaction between the two organizations. Handling of pay requests, processing of change orders, and daily inspections are all typical activities in the project management cycle, and misinterpretation is common in these activities. The inspector for the PWD can interpret a specification one way and the contractor's superintendent interprets the same specification to mean something entirely different. This may very well be the most challenging part of this relationship. Figure 13 illustrates the basic interaction between the PWD and the contractor. The contractor provides the construction expertise and labor resources for the project interactions, and the PWD provides daily inspections, project leadership, and contracting ability. The PWD and contractor are bound by a construction contract. The ultimate output from this relationship is a completed project and project as-built drawings.

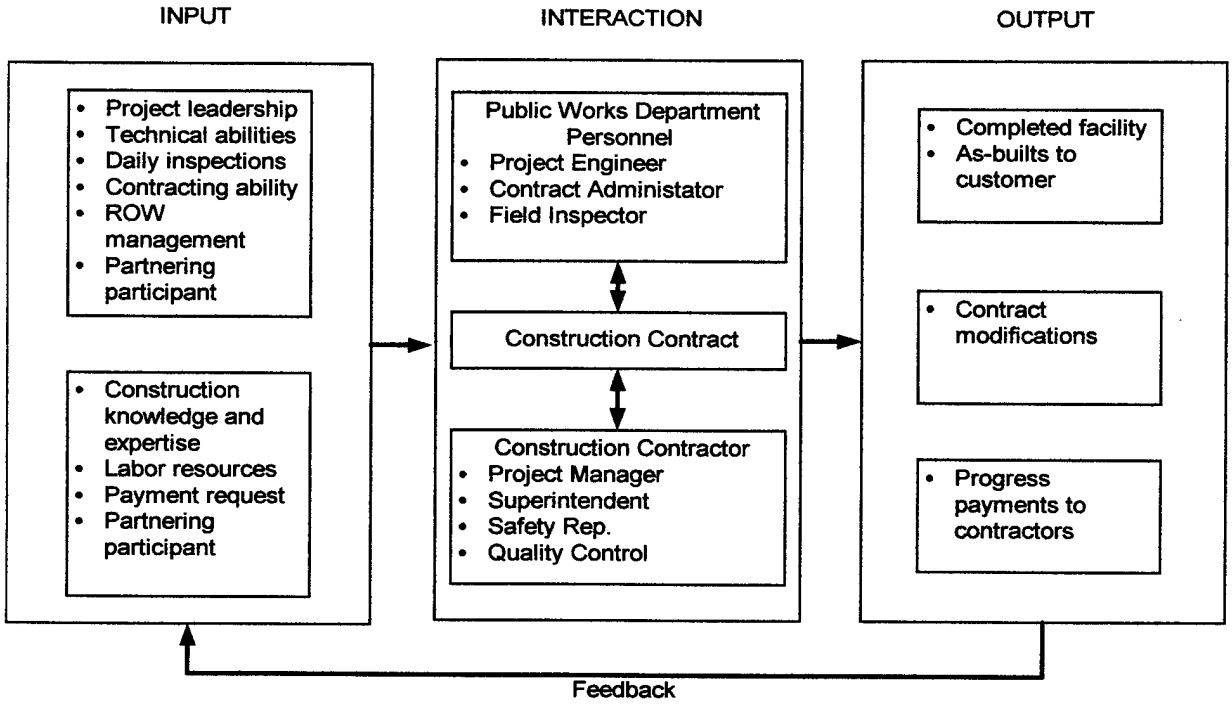

Figure 13: PWD interface with Construction Contractor

3.5.3 Interface with Design Consultant

The relationship between the design consultant and the PWD is one of extreme trust. The design consultants are selected due to their technical ability and expertise. They are the recognized experts on the design criteria for the project. The PWD selects the design consultant through a competitive basis and then provides a project scope and definition to the consultant, expecting a set of plans and specifications to evolve for the scope documents. The design consultant requires a well defined project scope to effectively design the project to the customer expectations, vague scopes result in numerous change orders, poor quality, and unsatisfied customers.

The design consultant provides various draft plans to be reviewed by the PWD and other agencies. Comments are compiled by the Project Engineer and return to the

design consultant. All of the different agencies have varying objectives, and conflicting comments will be received by the PWD. The Project Engineer and design consultant must determine the most appropriate comments to employ into the project's final plans and specifications.

The basic relationship between the design consultant and the PWD is depicted in Figure 14. Here the organizations are bound by an engineering service contract with the design consultant providing the engineering and technical knowledge to design the project. The PWD maintains project leadership and provides Texas Department of Transportation specifications, and a design review. Complete contract documents and approved permits are the desired outcome from this relationship. The process diagrams in Appendix A can also be reviewed for more information on the design activities and interfaces.

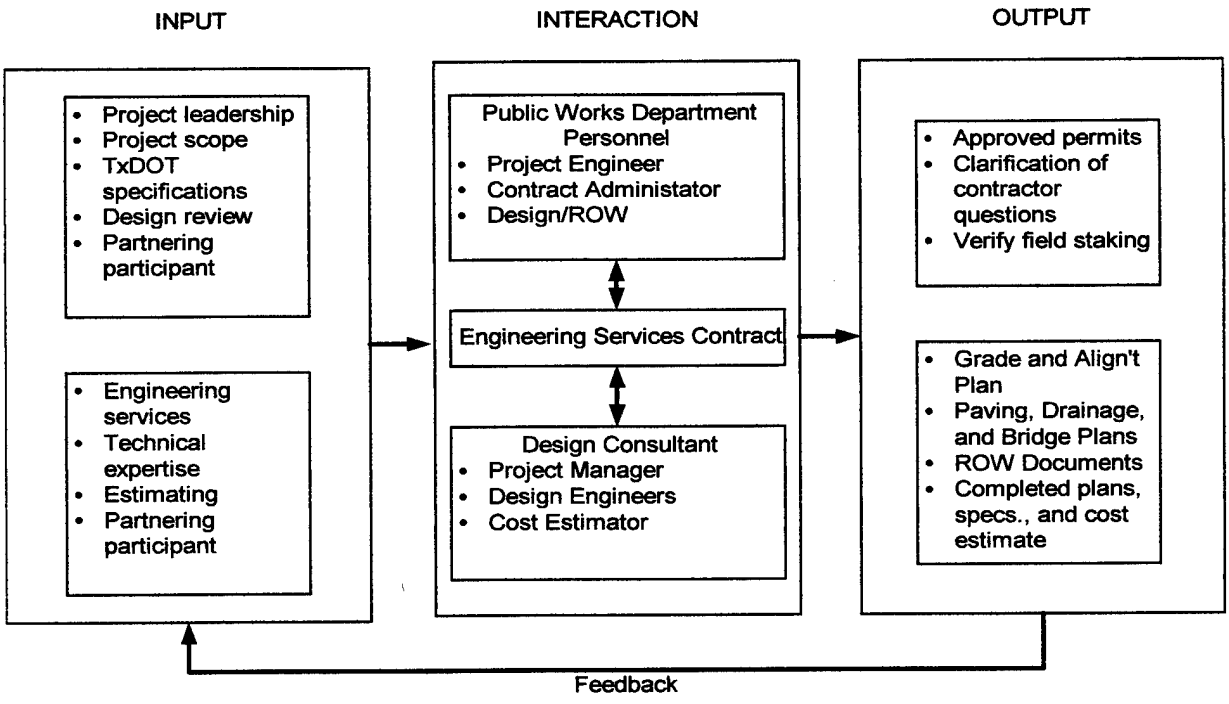

Figure 14: PWD interface with Design Consultant

3.5.4 Interface with Franchise Utilities

The interaction between the Dallas County PWD and the franchise utility companies is very dynamic and uncontrolled. In contrast to the PWD's interaction with the other agencies, there is not binding agreement with the franchise utilities to control the relationship between the two agencies. This presents a serious hurdle in the project management process if a disagreement is encountered with regard to utility right-of-ways interferences and/or utility relocation requirements.

It is important to coordinate with the franchise utilities throughout the project cycle. There may be multiple franchise utilities impacted by each PWD project and each utility company is independent of the administrative control of the PWD. Each franchise utility possesses its own project management process for design, cost estimating, and construction of the utility services. The design and construction schedules for the PWD projects must be coordinated for each individual utility. Timely notification on design and scope related issues is extremely important since utility relocation proceeds highway construction in most cases.

The use of monthly utility conferences, pre-construction conferences, and ROW agreements are critical in the relationship between the two agencies. The franchise utilities are also encouraged to participate in any partnering agreements and workshops to establish mutual commitment to project objectives. Figure 15 illustrates the basic relationship between the PWD and franchise utility companies, noting the absence of an interaction management vehicle between the two agencies.

A critical element in the project management process is the "adequate for utility relocation" notification. The Project Engineer for the PWD sends a formal notification to

each franchise utilities when the project design is substantially complete. This allows the utility companies to proceed with utility relocation services with an understanding than only minor changes will occur in the project design thereafter.

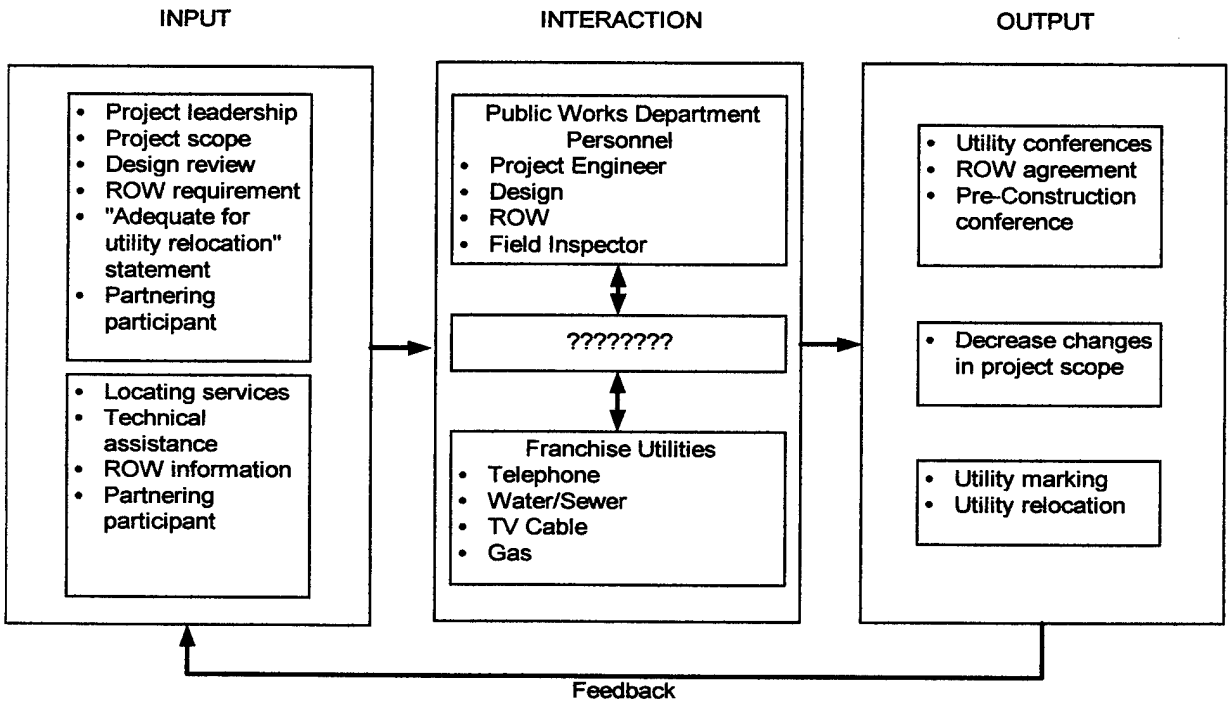

Figure 15: PWD interface with Franchise Utility Companies

3.6 Summary

This chapter has described the internal and external interactions of the Dallas County Public Works Department during the management of construction projects. As stated earlier the information found in this chapter was derived from the case study by Anderson and Back (1997).

The PWD's organization was reviewed and determined to have four divisions reporting to the PWD Director. The four division were stated to be Administrative Services, Transportation/Planning, Property, and Engineering/Construction. Each of

these division has very specific task in association with the management of the construction projects. The Project Engineer is the nucleus of the project management team. He/she is responsible for coordinating the efforts of the four division in the project management activities.

In the project management process at the Dallas County PWD, there are four general phases. These phases are planning, pre-design, design, and construction. Each of these stages has definitive inputs and outputs for each activity.

There are numerous internal and external interactions at the PWD during the project management process. The PWD divisions must be coordinated to provide services to the external interaction, which are municipalities, design consult, construction contractor, and franchise utility companies. The external interaction section only addressed four major sources of external interaction, but there are many more agencies with less frequent interface. Interaction with school districts, Texas Department of Transportation, and several other government agencies are all required in the course of the project management cycle.

Chapter 4: Organizational Conflict

As a Public Works Department interacts within itself and with outside agencies, conflict naturally arises during the development and execution of the various construction and maintenance projects. A manager's ability to manage this conflict, and minimize disruption, is the key for successful project ventures. Many authors argue that removing or minimizing conflict among the parties is more detrimental than helpful. Conflict is required to stimulate new ideas and challenge existing planning and construction processes that may can be done better.

Brown (1995) defines conflict as "a form of interaction among parties that differ in interests, perceptions, and preferences." There are several methods of classifying conflict. Some experts classify conflict by source and others by organization in which the conflict originates. The most common method of classifying conflict is by source of conflict. Three possible sources of conflict are described by Druckman (1993).

- Conflicts of Interest – When two or more parties involved in an interaction have a discrepancy in preferred outcomes.
- Conflict of Values – When two or more parties have different beliefs or ideologies.
- Conflict of Opinion – When the parties disagree as to "the best way to accomplish a shared goal."

These types of conflict typically result in the following types of organizational conflict (Jehn 1995).

- Relationship Conflict – Resulting from differences in personality; this type of conflict can be based on conflicts of values or opinions.

- Task Conflict – Involving disagreements about how to fulfill the organization's mission; this can include conflicts of interest or opinions.

Another method of classification is by the level of the organization in which the conflict originates. The following types of conflict have been defined by Rahim (1992)

- Intrapersonal Conflict (or role conflict) – Within the individual.
- Interpersonal Conflict – Between individuals.
- Intragroup Conflict – Within a group; typically resulting in the formation of competing preferences or opinions.
- Intergroup Conflict – Between the different groups in an organization or between organizations.

Within a Public Works Department any and all of these types of conflict may arise on a daily bases. As these conflicts occur there are several beneficial factors that result that aid in the project management steps, but there are also several detrimental effects which can disrupt the process. Table 1 below lists these beneficial and detrimental effects of organizational conflict. A successful manager is able to stress the benefits, while downplaying or redirecting the possible detrimental effects.

Table 1. Potential Beneficial and Detrimental Effects of Organizational Conflict

Beneficial Effects	Detrimental Effects
Improved organizational decision making	Stress and job burnout
Improved communication, as individuals are forced to clarify their positions	Reduced communication, as individuals fall back on positional bargaining
Improved brainstorming	Distrust and suspicion
Synergistic solutions to common problems	Reduced job satisfaction
Stimulation of innovation and creativity	Increased resistance to change
Enhanced individual and group performance	Reduced organizational commitment and loyalty

Note: Adapted from Rahim (1992)

Project Engineers, Construction Inspectors, and other member of the Public Works Department (PWD) experience these factors everyday during the course of performing their duties. The PWD personnel must attempt to resolve the conflict to the best of their ability, but PWD management can provide assistance. This can be accomplished by establishing the correct work environment, setting policies, and employee selection. Obviously, the PWD Director can not dictate or control who other agencies establish as their Point of Contact (POC) for the various construction projects, but the personnel employed by the PWD and their positions can be impacted by his/her preferences. The following section will describe some conflict management techniques that have been proven to be highly successful for many top management teams in private and public organizations.

4.1 Conflict Management

Conflict management is the art of dealing with differences of interests, perceptions, and preferences, in order to maximize organizational effectiveness. Every manager has his/her own conflict management method based on personality and leadership style (Singh and Johnson 1998). In the private sector top management teams typically face situations with high ambiguity, high stakes, and extreme uncertainty. Conflict, debate, and disagreements are all natural reactions to this environment. Successful conflict management includes the development and monitoring of conflict in the organization or group. As conflict encourages debate and the development of new ideas, it can become an inhibitor if unchecked by the management. Conflict monitoring is essential to reduce negativity and disruption in the work environment. Several

mechanics to develop conflict and method to monitor conflict will be outlined in the following paragraphs.

4.2 Conflict Development

A case study by Eisenhardt, Kahwajy, and Bourgeois (1998) found that reasonable people perceive the ambiguous and uncertain world in different ways, to make differing assessments about what might happen in the future, and to prefer different alternatives. From this study they found that highly successful corporate executives actually sought out these differing viewpoints for their management teams. They found that the conflict generated by the team members led to the consideration of more alternatives, better understanding of the choices, and overall, significantly more effective decision-making. Several other authors have also linked high conflict to superior performance and low conflict levels to poor decision making. In these cases the team members become apathetic, disengaged, and ultimately achieves on average or lower performance. From their evaluation of twelve technology-based firms they determined that there were four tangible levers of conflict management that appeared to be universal mechanisms for creating conflict. These levers of conflict management are listed below:

- Heterogeneous Teams,
- Frequent Interaction,
- Distinct Roles, and
- Multiple Lens Heuristics.

The management teams who employed these levers were highly successful. Table 2 summarizes these levers and their implications. The following paragraphs will

further describe the different levers and their associated impacts upon the management teams performance.

Table 2. Conflictual and Non-Conflictual Top Management Teams

Conflictual	Implications	Non-Conflictual	Implications
• Assemble hetero-geneous teams, including varying ages, gender, and functional backgrounds	• Adds multiple perspectives • Heightens awareness of potential conflicts	• Create homogeneous teams, emphasizing similarities and common culture	• Loses multiple perspectives • Lessens awareness of potential conflict
• Frequently and intensely interact	• Builds a team of "friends" who feel confident to express dissention • Sharpens understanding of issues and preferences	•Rarely conflict	•Builds a group of "strangers" who lack familiarity • Keeps preferences and issues unclear
• Cultivate a symphony of distinct roles	• Adds new perspectives, especially around fundamental tensions such as short vs. long-term and status quo vs. changes	• Defaults to obvious, roles such as functional, division or geographic ones	• Encourages parochial debates around familiar tensions
• Rely on multiple-lens heuristics	• Motivates multiple and unique vantage points	• Avoid conflict-inducing tactics	• Settles for obvious perspectives and first solutions
Note: Adapted from Eisenhardt, Kahwajy, and Bourgeois (1998)			

4.2.1 Heterogeneous Teams

The building of heterogeneous teams is one path to creating conflict within the management group. These teams have members who are from different education backgrounds, gender, functional backgrounds, and ethnic groups. Teams that are made

up of these differing demographics are more likely to have conflict. Age differences are also particularly significant for creating conflict within the group or organization. The older members of the team tend to rely upon expertise drawn for year of experience in the industry, while the younger members are more likely to have fresh perspectives on new ideas and technology. For organizations that have a hard time obtained this differing demographic heterogeneity, the inclusion of a consulting firm can achieve similar results. The importance of establishing a heterogeneous management group is to obtain differing viewpoints and create debate. From Table 2, a PWD who builds heterogeneous teams can increase their awareness of potential conflicts and add multiple perspectives during the course of the project management process. The PWD might accomplish this by hiring new employee from a different region of the country or hire experience personnel from other PWDs instead of promoting within. An aggressive recruiting program of minorities and women will also increase the heterogeneous stature of the PWD.

4.2.2 Frequent Interaction

When PWD team members have a poor understanding of others team members points of view, conflict is ineffective or even non-existent. Meetings or at least frequent interactions are required for conflict to arise. Each group member learns more about the other group members' positions and responsibilities through frequent interaction in an established formal meeting, private office discussion, or even sociable discussions around the "water cooler." This allows the group members too more intelligently debate topics when they know the other members abilities and limitations. The group members also become more familiar with each other on an individual basis and are more likely to offer a differing option to someone they know without fear of antagonizing or offending.

Project Engineers, Field Inspectors, and other PWD personnel can work better together when they understand each other's responsibilities.

4.2.3 Distinct Roles

A third tactic for creating conflict is cultivation of a symphony of distinct roles. Most team members naturally migrate to a typical role position during meetings and discussions. Often these roles are organized around poles of conflict that are natural with business. In particular, five distinct roles are apparent in most of high conflict teams: Action, Steady, Futurist, Counselor, and Devil's Advocate (Eisenhardt, Kahwajy, and Bourgeois 1998).

The "Action" role is looking for the quick answer and not particularly concerned about the long-term impacts. The "Action" role player creates conflict by constantly bringing up new ideas and pushing the group for a decision.

Another common role is the "Steady" role player. This role is typically employed by the older members who prefer structure and planning. This group member maintains the attention to detail to ensure that nothing is overlooked. Many times these personnel are considered leveling influences and are advocates for caution.

The next distinct role is the Futurist. These group members are constantly looking into the future to plan and have difficulty concentrating on the short-term issues. They typically exhibit a visionary grasp of the long-term fundamentals for the industry and agency. The Futurist is a stark contrast to the "Action" role.

The Counselors roles are normally the older members of the management team. They have years of experience and bring wisdom to the group. Their advice and counsel are highly regarded.

The final role is that of the Devil's Advocate. This member is a challenger of theory and frequently offers objections to proposed courses of action. Many times this role is filled by a junior member of the management team who lacks the experience or confidence to present their own points of view, but does feel comfortable offering dissenting points of view.

All of these roles are essential for creating conflict. These roles give the group members the latitude to debate about the fundamental tension between stability and change, and the confidence to engage in dissenting viewpoints. Any organization contains a fair share of personnel with these distinctive role traits. The trick for the PWD is to gather and maintain the roles within the same group. The PWD can develop new and innovative approaches to contract management problems and constructibility issues by using the distinctive role lever. Table 2 states that groups without distinctive role models continue to debate old problems, and not develop the new ideas that are needed. Each role is necessary to stimulate the other members to creative thinking and planning for the groups parent body.

4.2.4 Multiple Lens Heuristics

Another mechanism to create conflict is the use of multiple-lens heuristics. These heuristics are useful to a public works department when particular issues arise by creating multiple perspectives and alternatives on the issues. There are four heuristics identifies by Eisenhardt, Kahwajy, and Bourgeois (1998) that are particularly effective: multiple alternatives, multiple scenarios, competitor role plays, and overlapping subgroups. These heuristics set the stage for conflict by preventing the managers from settling too soon on the obvious. The first heuristic examined is multiple alternatives. Here multiple options

are created and presented for the issue at hand. Alternative paths are developed to expand innovation and to go beyond the obvious solution that first comes to mind. The practice is to create multiple alternatives then narrow the range to the more plausible options for consideration and final selection. It is also important that all options be developed whether they are politically favored or not, creating as large of a selection field as possible for the decision makers.

The next heuristic considered is multiple scenarios. Unlike the heuristic discussed in the previous paragraph which develops multiple alternatives for a single scenario, this heuristic develops several completely different courses of action for strategic decisions on possible future demands. The development of the different scenarios forces the management team to start with the future and think backward in time to the present. This provides a different perspective for understanding the pending issues and their future impacts.

The playing of competitor role is the third multiple lens to be discussed. Here one or more of the team members are responsible for developing the perspective of competitors and then presenting that perspective to the management group. This provides the framework to view critical issues from a different angle and look beyond the obvious.

The last multiple lens heuristic is overlapping subgroups. Any group or team is generally divided into several working subcommittees. The subcommittees are focus on particular issues and are able to gain greater familiarity with issue and each other due to the smaller group size. Due to the smaller group, each member is able to discuss the topic in greater detail and perspective. Conflict arises in the subcommittee as matter of

course, but greater conflict occurs when the subcommittee presents its ideas to the larger management group. Dissenting ideas and options are the normal occurrence as the different distinctive roles react to the information presented.

Multiple lens heuristics are successful because they are motivating and encourage debate. Management groups are generally compelled to develop more alternative and scenarios as a matter of their competitiveness. The team members become engaged in the manipulation of the different ideas and increase the range of perspectives.

By employing this mechanism to generate conflict, a PWD can increase its effectiveness by developing new and innovative ideas during constructability review, project scope determinations, and means to solve difficult project changes when funds are restricted. In these processes, the PWD can use the multiple lens heuristics to establish teams within the project management team to simultaneously study the same issue. Each team will develop a different method to resolve the issue, then the group as a whole can review all of the ideas and select the best one for implementation.

4.2.5 Conflict Incentives

Not all methods of developing conflict are related to person traits or group demographics, one method to increase the amount of conflict or debate in an organization is to issue rewards for innovative ideas and positive changes. By establishing incentive programs for cutting edge ideas and innovation, a group can positively increase the debate within the organization. These incentives may be monetary, time, or recognition oriented. An organization may employ all of the type of incentive listed. The level of reward can be based upon the level of debate generated and value of the idea. Ideas that may a dramatic impact on the organization effectiveness may receive a worthy cash

reward, while employees with less influential ideas may receive time off or recognition in form of a plaque or certificate.

4.2.6 Summary of Conflict Development

In summary, high conflict management teams have more distinct viewpoints, which leads to more thorough discussions during the decision making process and help avoid the premature closure to pending issues. As a practice public works departments should strive to assemble as diverse a team as possible, meet together as team frequently, encourage team member to assume roles beyond their functional responsibility, use multi-lens heuristics and think in terms of managing conflict, and reward the employees when ever possible for innovative ideas. By using these techniques the PWD can enhance its internal and external interactions, and obtain new perspectives on new and reoccurring problems.

4.3 Conflict Monitoring

It is obvious that too much conflict can result in disturbed relationships and symptoms of organizational sickness, however, too little conflict can also cause organizational dysfunction, including organizational myopia (lack of foresight), and complacency (Brown 1995). With this in mind a manager must be able to balance the conflict to attain maximum organizational performance. This dictates that the manager must diagnose the current state of conflict in his/her organization or group and develop strategies to mitigate or instigate conflict, which ever the case may be. An adequate conflict diagnosis should include the following (Rahim 1992 and Brown 1995):

- sources of conflict,

- conflict frequency,
- conflict intensity,
- conflict management styles , and
- the group's position on the conflict balance (too much or too little conflict).

There are several types of conflict management styles that may be employed. Singh and Vlatas (1991) identified the five primary styles to be (1) withdrawal; (2) smoothing; (3) forcing; (4) compromise; and (5) problem solving. In an effort to determine which style is most preferred in a public works type organization, Singh and Johnson (1998) developed a rating system to compare a production quotient versus a people quotient. Three questions were developed for three interaction categories. These categories were defined as supervisor conflict, co-worker conflict, and subordinate conflict. These questions were complied into a questionnaire and given to a state public works organization to determine the preferred conflict management style for that agency. Copies of the questionnaires are provided in Appendix B. After the questionnaires are completed by several personnel at varying levels of management within the public works type agency, the following equations are used to determine the production quotient and people quotient.

Production quotient

= (number of forcing responses + number of problem solving responses)

– (number of smoothing responses + number of withdraw responses)

People quotient

= (number of smoothing responses + number of problem solving responses) – (number of forcing responses + number of withdraw)

From this analysis a conflict management grid can be formulated to show the preferred conflict management styles (Figure 16) (Singh and Johnson 1998). The preferred conflict management style can be obtained from Figure 16 by calculating the people quotient and production quotient, then following the grid lines and plotting the point. The grid system for determining the preferred conflict management style is based upon a quadrant system. The established scoring system and the grid system match.

Table 3 illustrated the same information, but in a tabular format. Singh and Johnson developed this table off of the same principals as Figure 16, but Table 3 provides a different way of analysis the data.

Table 3. Conflict Management Style as Determined by Production and People Quotients

If the production quotient is	And the people quotient is	The resulting preferred Management style is
Less than or equal to zero	Greater than zero	Smoothing
Greater than zero	Greater than zero	Problem Solving
Zero	Zero	Compromising
Less than or equal to zero, so long as the people quotient does not also equal zero	Less than or equal to zero, so long as the production quotient does not also equal zero	Withdraw
Greater than zero	Less than or equal to zero	Forcing
Note: Adapted from Singh and Johnson (1998)		

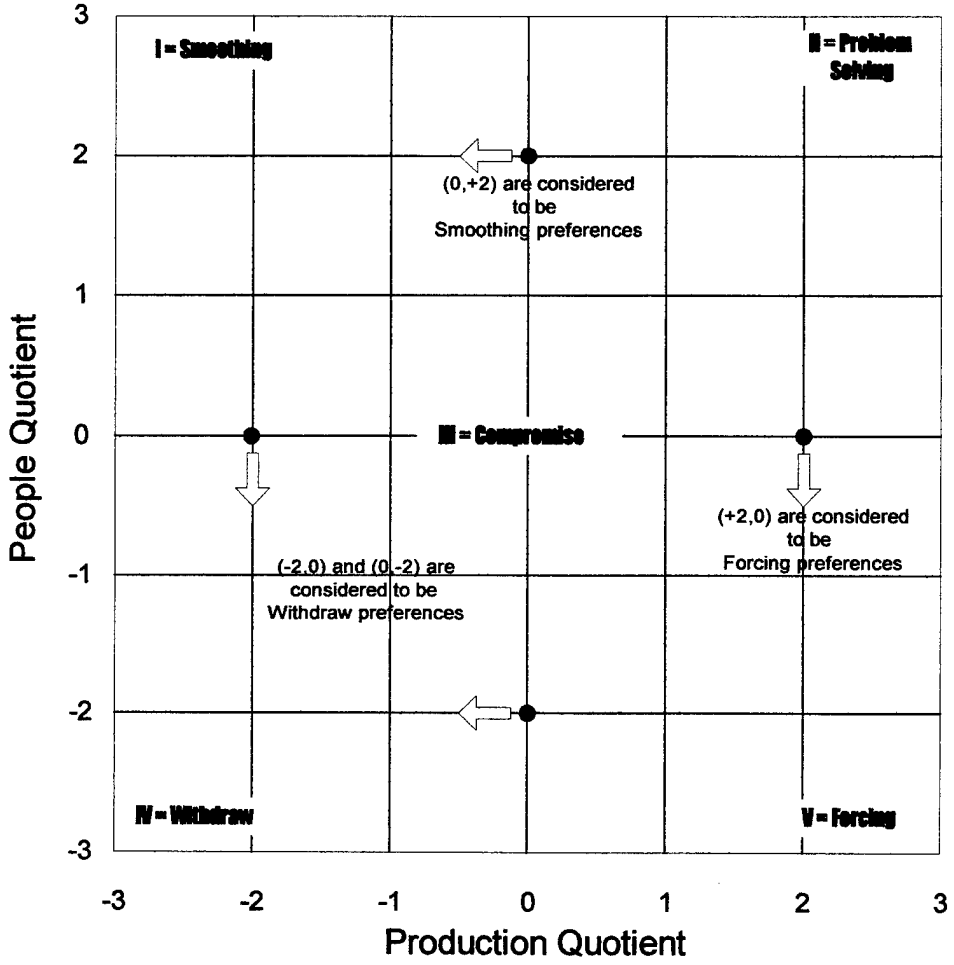

Figure 16: Conflict Management Grid with Production and People Quotients

The questionnaires were given to a public agency that engaged in the design and construction of civil engineering project. Respondents selected the conflict management style they preferred for the given question and then all of the respondents answers were combined to provide the resulting preferred conflict management styles listed in Table 3. The sampling results show that the vast majority of the respondents prefer the problem solving conflict management style. Overall, more than 60% preferred the problem solving management style, approximately 20% choose the smoothing style and 10% preferred the forcing style for conflict management.

Table 4. Preferred Conflict Management Styles

Preferred Style	INTERACTION WITH						Combined Index	
	Supervisor		Coworker		Subordinate			
	n	%	n	%	n	%	n	%
Smoothing	10	21.3	1	2.1	0	-	4	8.5
Problem Solving	28	59.6	33	70.2	19	86.4	40	85.1
Compromise	3	6.4	7	14.9	1	4.5	2	4.3
Withdraw	1	2.1	2	4.3	0	-	0	-
Forcing	5	10.6	4	8.5	2	9.1	1	2.1
Note: Adapted from Singh and Johnson (1998)								

By using the method presented a manager can determine a preferred method of conflict management. However, this does not indicate the frequency or intensity of the conflict level within the organization. To determine these values Singh and Johnson (1998) developed a scoring scale to measure the intragroup and intergroup conflict frequency and intensity for common project management sources of conflict. The scoring scale is illustrated in Table 5. The common sources of conflict in a project management environment were determined by Thamhain and Wilemon (1975) to be:

- project priorities,
- administrative procedures,
- technical opinions and performance trade-offs,
- budget resources,
- cost of project,
- schedules and manpower, and
- personality.

Table 5. Scoring Scale for Conflict Frequency and Intensity

Score	Conflict frequency	Conflict intensity
4	Very often	Very severe impact
3	Frequently	Quite severe impact
2	Sometimes	Somewhat severe impact
1	Seldom	Slight impact
0	Never	No impact
Note: Adapted from Singh and Johnson (1998)		

The same public works agency was asked to evaluate its intragroup and intergroup conflict. Two departments participated in the data sampling (Design Department and Construction Department). The respondents were asked to rate the frequency and intensity of the seven common sources of conflict listed above within their agency. A sample of the questionnaire is attached in Appendix C. Each common source of conflict was rated based upon the scale indicated in Table 5 for both frequency and intensity. The data was collected and mean values were determined for each source of conflict in regards to either intragroup or intergroup conflict. Table 6 summarizes the results for the Design Department and Table 7 summarizes the results for the Construction Department.

Table 6. Comparison of Design Department Conflict Frequency and Intensity

Conflict source	Conflict Frequency		Conflict Intensity	
	Intragroup	Intergroup	Intragroup	Intergroup
Project priorities	1.59	1.53	1.29	1.00
Administrative procedures	1.94	1.65	1.71	1.53
Technical opinions	1.53	1.76	1.47	1.53
Budget resources	1.41	1.53	1.29	1.18
Cost of project	1.41	1.53	1.41	1.24
Schedules and manpower	1.94	1.24	1.82	1.0
Personality	1.53	1.29	1.35	1.24
Mean Score	1.62	1.5	1.48	1.25
Note: Adapted from Singh and Johnson (1998)				

Table 7. Comparison of Construction Department Conflict Frequency and Intensity

Conflict source	Conflict Frequency		Conflict Intensity	
	Intragroup	Intergroup	Intragroup	Intergroup
Project priorities	1.67	1.48	1.23	1.31
Administrative procedures	1.94	1.41	1.55	1.31
Technical opinions	1.68	1.72	1.39	1.55
Budget resources	1.58	1.41	1.39	1.28
Cost of project	1.65	1.52	1.45	1.45
Schedules and manpower	1.87	1.52	1.68	1.48
Personality	1.81	1.28	1.77	1.17
Mean Score	1.74	1.48	1.49	1.36
Note: Adapted from Singh and Johnson (1998)				

Neither the intragroup nor the intergroup conflict frequencies or intensities were high in either department. In fact, all of the mean values for the conflict measurements ranged between seldom to sometimes (Rating Score of 1 and 2). A correlation of the different scoring values revealed a correlation factor of $r = 0.89$ between intragroup conflict frequency, while the intragroup conflict intensity was $r = 0.49$. This indicates that what causes intense conflict in one department does not necessarily cause intense conflict in the other. The frequency of conflict from different sources impacts both departments similarly. The correlation between the intergroup frequency and intensity were $r = 0.55$ and $r = 0.16$, respectively. These low correlation factors indicate that the two departments have different views of the intergroup conflict. However, the mean frequencies and intensities are very similar and the authors concluded that the scores between the two departments are not very different.

From the analysis the authors concluded that the organization is experiencing low levels of conflict. They concluded that this was due to two factors.

1. The hierarchical design of the organization.

2. The administrative procedures that are so common to government organizations.

4.4 Summary

Conflict is not something to be avoided unless in excess. Management teams and organizations require moderate to high levels of conflict to increase their effectiveness. This is particularly true in the project management area, where there is constant change that demands the attention of the project management staff. This chapter discussed the importance of conflict management. Several methods to develop conflict in low or non-existent conflict teams were presented. The ability to generate conflict and manage its impact is the key to keeping the project management team humming along instead of getting bogged down in the disruption of too much conflict or become complacent in times of low conflict. The methods presented to monitor the conflict are extremely beneficial to a Public Works Department. The questionnaires in Appendix B and C can be distributed on an established basis to monitor the current status of the conflict with the organization or project management team. From these surveys management can evaluate if excessive conflict is present within the organization or project management teams or if conflict needs to be interjected into the organization's activities.

Chapter 5: Interaction Management Tools for Conflict Resolution

Infrastructure is defined as the basic facilities and installations that serve social purposes of health, safety, economics, employment, and recreation (Rainer 1990). Deterioration of the infrastructure can negativity affect economic activities and quality of life, whereas a well maintained system helps attain an efficient distribution of population and industrial activities (Queiroz, Hass, and Cai 1994). With these conditions in place it is not unusual for the large public projects to be highly controversial. Frequent conflict occurs as the projects adversely impact certain groups or at least form the impression that negative impact will occur to certain geographic areas or demographic groups.

Public opinion can quickly sway the public policy and decision makers from their original position on the project. Scope changes and change orders usually ensue, possibly creating adversarial relationships between the public works department, contractors, designers, and clients. As the public works department programs, develops, and executes the various infrastructure projects, the project managers must be able to identify and resolve these conflictural issues so to not impede the progress of the project.

Disagreements with contractors, design consultants, and other agencies is also a common source of project disruption or conflict. Differing views on what the contract documents intent, and how construction and safety regulations are perceived generates a multitude of project management problems. The relationship with these companies and agencies can quickly become adversarial due the frequency or intensity of the disagreements.

Several management tools have been developed to assist project management in identifying, preventing, and resolving these controversial issues. This is not to say that

all public concerns, contractual issues, or regulation disputes can be resolved, but at least these management tools are effective with the majority. This chapter will briefly discuss some interaction management tools useful for conflict resolution.

These interaction management tools are not the "cure-all" for the issues concerning public concern and contact disputes, but provides the vehicle for the groups or agencies to come to an agreement on the terms of the issues. The earlier these interaction management tools are employed the sooner the groups can work out acceptable agreements.

5.1 PWD Conflict Resolution

Within the Dallas County Public Works Department there is a notable disparity between the intragroup conflict level and the intergroup conflict level. There appears to be substantially more conflict associated with external interfaces than internal interfaces. The different divisions of the PWD do not appear to generate any significant amount of debate or conflict within the public works department, while relationships with contractors, design consultants, municipalities, and franchise utility companies sometimes results in high levels of conflict. There are several reasons for the conflict level difference and they can be related to the causes of conflict identified by Gibson, Ivancevich, and Donnelly in Figure 17.

To mitigate the conflict levels for both internal and external relationships, many different management tools and resolution techniques can be employed by the project manager and the public works department. Several types of resolution techniques were briefly discussed in the previous chapter, but Figure 17 outlines the framework for conflict resolution.

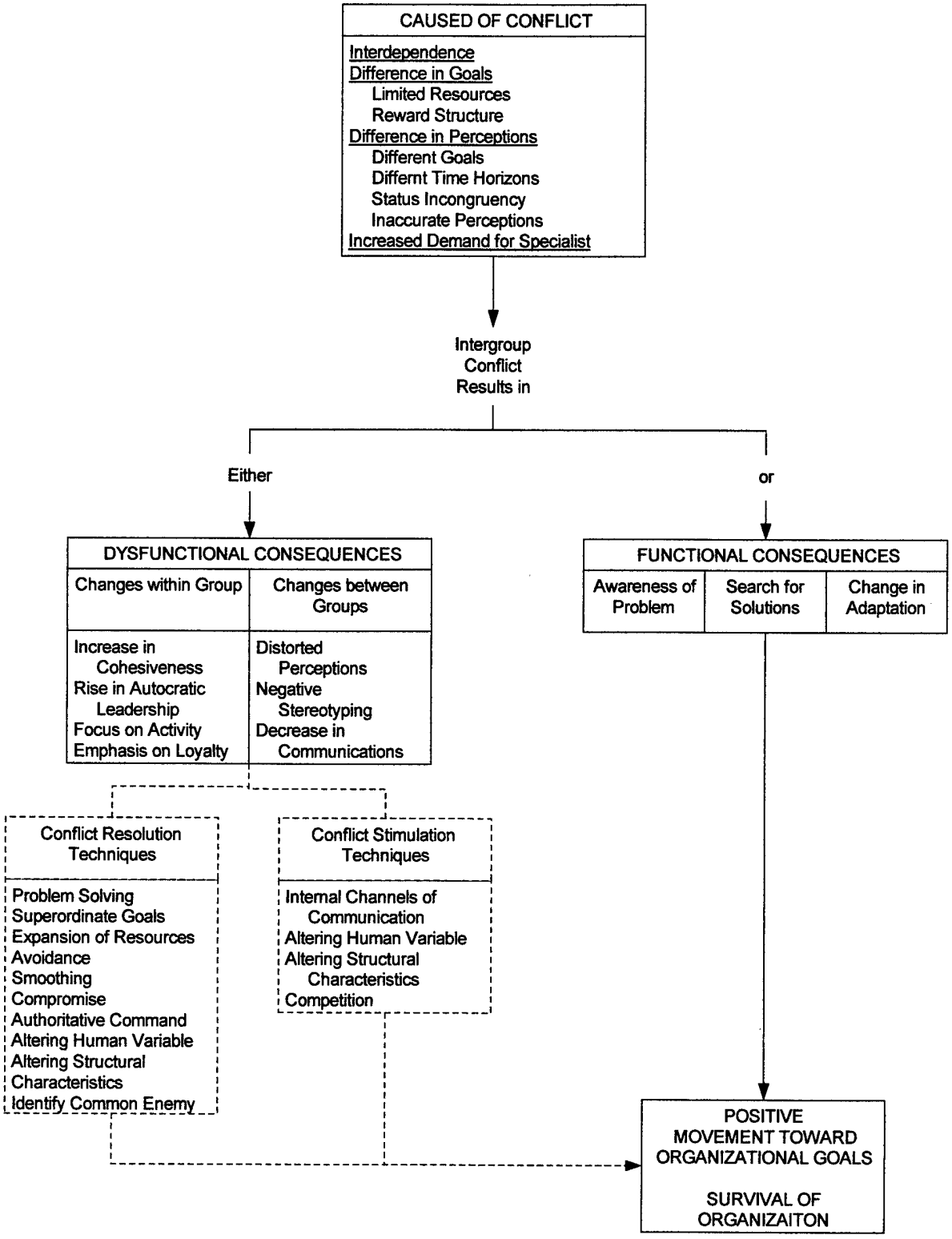

Figure 17: An Overview of Intergroup Conflict

5.2 External Conflict Resolution

The number of external relationships for a public works department is tremendous. The Dallas County public works department must coordinate with multiple contractors, numerous design consultants, several independent municipalities, and many other government and non-government agencies to complete the project management activities. Given the number and frequency of these interactions, conflict is almost certain to occur. As shown in Figure 17, intergroup conflict can result in either dysfunctional consequences or functional consequences. The PWD must be able to mitigate and resolve conflict for project objectives to be achieved. The PWD must generate and establish interagency working agreements and interaction management tools to facilitate the resolution of any dysfunctional conflict and manage the functional conflict.

Formal agreements can be established to outline the basic relationship between the PWD and the other agencies. The Dallas County PWD has established these agreements with the contractors (Construction Contract), design consultants (Engineering Service Agreement), and municipalities (City/County Agreement). However, no formal agreement has been established with the franchise utilities or other agencies. This does not seem to present a problem with most of the agencies, but the lack of an agreement with the franchise utility companies does create many problems.

The resolution techniques outlined in Figure 17 are effective at resolving dysfunctional conflict, but some type interface management tool must be employed to facilitate the techniques. Two such methods are partnering and fabricated organizational structures. Both of these will be discussed in the following paragraphs.

5.2.1 Partnering

Partnering is well known management tool used by groups to form common goals and objectives before proceeding with project. According to the Construction Industry Institute (CII) (In search 1991), partnering is "a long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organizational boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each others individual expectations and values." Partnering is used extensively in both the private and public sectors.

The Dallas County Public Works Department uses partnering as an essential role in their project management process. To the extent that Anderson and Back (1997) developed a process diagram for the partnering process. The PWD's partnering process can be observed in Process Diagram 16 in Appendix A and is reproduced in Figure 18. This model can be used to represent the steps of a typical partnering agreement. From the diagrams we see that the key members in the partnering process are the Project Engineer for the PWD, the contractor, a facilitator, and city representatives. Franchise utility companies are also invited to join the partnering workshop(s). The first step of the process is getting the initial key player to agree to partner. The contractor and PWD officials must have agreement that both parties wish to partner on the project and then develop the agenda for the partnering workshops. The next step is to select a facilitator. The list of facilitators is review by the PWD and contractor. Once the facilitator has been selected the partnering workshop can be

conducted. The output from the workshops is aligned project objective, common goals, and a signed partnering agreement.

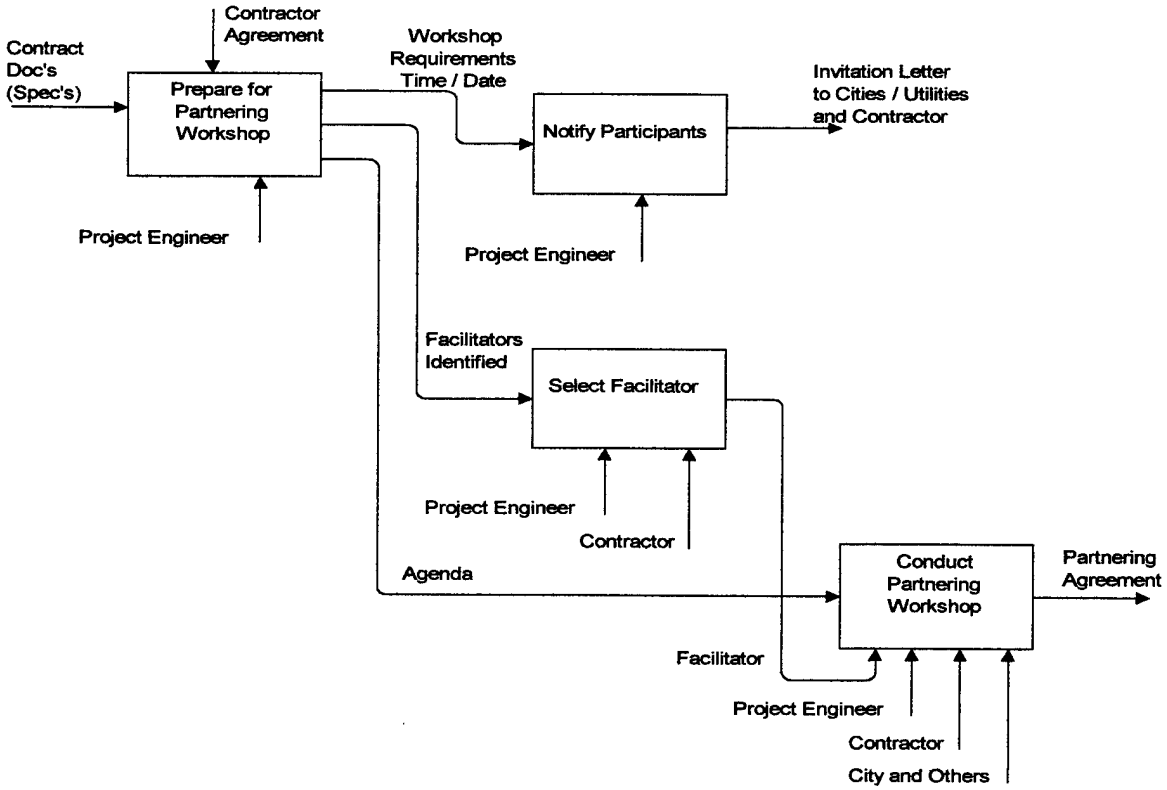

Figure 18: Partnering Model for Dallas County PWD

The benefits of partnering very greatly with the range of application. Partnering can exist with competitive bid single projects to more non-traditional contracting methods such as deign-build projects and partnership oriented construction programs. To further study the benefits of partnering, CII commissioned the Partnering II Research Team in 1994. The team gathered data from more than 1,000 projects associated with these relationships and the results were overwhelmingly positive, and validated the choice to partner (Sanders, Thompson, and Crane 1996).

The benefits of partnering dramatically increase as the relationship is unified and developed, and such attention to the relationship often includes an acceptance of uncertainty and willingness to be vulnerable (Thompson and Sanders 1998). For partnering benefits to increase the participants must devote time and effort to fostering a positive relationship. The amount of resources expended in the partnering process is directly related to the potential level of benefits. Individuals who invest limited resources can not expect to attain the same result as those who have expended significant resources. A lack of familiarity with partnering has also impacted the potential benefits for many individual who think that partnering only applies to long-term relationships where large amounts of resources are required.

Based upon these principles, Thompson and Sanders developed the Partnering Continuum. This summarizes that as the objectives are more aligned the better the potential benefits of partnering. The continuum can be segmented into four categories, with each representing a new level of alignment. The four stages can be classified as competition (the traditional approach in the absence of partnering), cooperation (focused on reaching agreement through compromise), collaboration (achieving process improvements through teamwork), and coalescence (reengineering the process to fit the application). For each of these stages the potential benefits can be compared to the degree of objectives aligned. This graphical representation is illustrated in Figure 19. The following sections will describe characteristics and benefits of each general stage (Thompson and Sanders 1998).

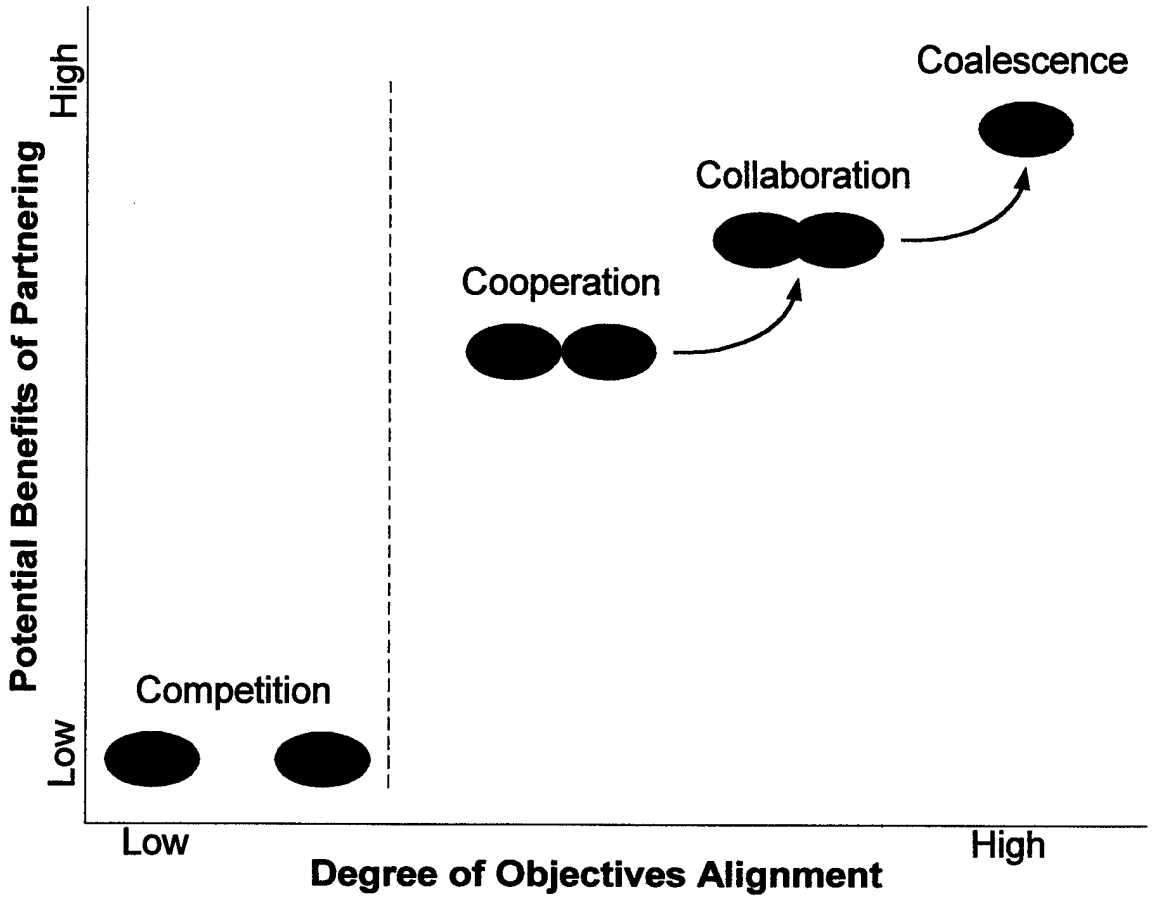

Figure 19: Partnering Continuum

Competition is different from the other stages due its focus on separate agendas. The three partnering approaches focus on utilizing partnering techniques to achieve common goals. The type of partnering should be selected which meets the objectives of a particular situation. Each instance is different and a management group cannot copy an earlier or existing partnering relationship to a new situation and achieve the same results.

In the past, typical public works projects were developed using the traditional design/bid/build contracting strategy. This made the bidding process very competitive with the low bidder getting the job (pending the bid package is complete and responsive).

In traditional construction relationships the parties enter into the project focused on achieving their objectives and profit margins. The only common goal may be project completion. This means of achieving this goal are often different and contrary with others. There is little regard for impact to other parties in the relationship. Characteristics of the competitive stage include:

1. No common objectives; they may actually conflict.
2. Success coming at the expense of others (win/lose mentality).
3. Short-term focus.
4. No common project measures between organizations.
5. Competitive relationship maintained by coercive environment.
6. Single points of contact between organizations.
7. Little trust, with no shared risk; primarily a defensive position.

These characteristics many times lead to conflict, project disruption, litigation, and often-disastrous projects. Most public works agencies have followed the lead of the U.S. Army Corps of Engineers and are embracing the partnering concept to reduce these negative issues. Partnering can still occur between the PWD and contractor in a competitive bid process, but much of the contractor's ability to agree to common objectives is lost during the competitive bidding process.

The other three categories (cooperation, collaboration, and coalescence) are all somewhat typical of a design/build project. PWDs and other government construction agencies are beginning to use the design/build contracting strategy to reduce cost and improve quality. The benefits of partnering are much greater than in the competitive environment.

At this stage parties are willing to focus on the goals and objectives of the project. Individual goals are satisfied in the process of working toward the common goals. Trusting relationships are developed by relaxing controls, accepting influences, and sharing information. As these actions occur, each company becomes more vulnerable to the abuse of the other. If vulnerability is rewarded by each company performing competently and maintaining confidentiality, trust is established between the parties (Zand 1972). Characteristics of a cooperative environment include:

1. Common objectives.
2. Improved interpersonal relationships.
3. Long-term focus on accomplishing the strategic goals of involved parties.
4. Common measurement system for the projects and the relationships.
5. Improved processes and reduced duplication.
6. Relationship-specific measures tied to team incentives.
7. Shared authority, openness, honesty, and increased risk sharing.

The formation of the partnering charter is the single-most beneficial tool in developing a partnering relationship (Thompson and Sanders 1998). When multiple parties come together, share their concerns and positions, and incorporate these discussions into a set of ground rules and common goals, the stage is set for success. Increased communications, working relationships, and increased trust and respect are expected of a team using project specific partnering. Through partnering many government agencies have documented a pronounced decrease in litigation. Schedule reduction, cost reduction, staff reduction, and reduction in engineering rates are all

documented achievements in the public sector by the use of partnering (Sanders, Thompson, and Crane 1996).

Continuous improvement, decreased duplication, and improving work process are the benefits to be achieved by the open sharing of information between parties. Each party comes to understand the wants and needs of the other, providing better attitude and an appropriate knowledge of the type of service requested. These agreements encourage the development of trust between the parties as the contractual commitment is extended, increased willingness to accept additional risk for possible increase rewards. Open sharing between the parties inspires innovative perspectives to emerge, revision of existing processes, and continuous improvement. Openness, honesty, and trust are considered absolutely critical to the relationship (Cohen, Fink, Gadon, and Willits 1995).

Each of the levels of the Partnering Continuum has its place within and between public and private organizations. The owner should select the version of partnering which best achieves the defined goals. In this process the owner should define their business objectives, understand benefits expected from each level, identify resources to be dedicated to the partnering effort, and selection of partner(s) to determine the most appropriate version of partnering.

Now that the partnering process has been defined and discussed, the methods to measure the effectiveness of the partnership can be addressed. It is important to identify and develop a set of measures to help manage the partnering process and gauge progress toward established goals (Sanders, Thompson, and Crane 1996). These measures should be developed to support the objectives of the specific partnering agreement. In contrast to partnering objects, which are long-term and strategic, partnering measures should be

short-term and specific. These measurements should act as a management tool for ensuring the partnering objectives are meet. These measures should focus on milestones and serve as "yardsticks" to measure the progress.

Some typical relationship measures are (Crane, Felder, Thompson, Thompson, and Sanders 1999):

- Internal communication
- External communication
- Meeting effectiveness
- Leadership
- Internal Trust
- External Trust
- Teamwork
- Problem Solving

There are three levels of measure in a partnering relationship. Result, process, and relationship measures each have their proper place. The result measuring process only occurs when an activity is complete, therefore, the process is does not provide an insight when forecasting future developments. Relationship and process measures monitor ongoing activities and can be used to provide trend information to the decision-makers.

5.2.2 Fabricated Organizational Structures

Fabricated Organizational Structure (FOS) is designed to advance decision-making in public policy environment through a stepwise approach. The goal of FOS is to obtain stakeholder input and to formulate and promote decisions by policymakers (Wakeman 1997). This process is somewhat similar to partnering, but concentrates more on the establishment of the best organizational structure. FOS stipulates that if the best organization is in place then a community agreement around a common vision can be established.

The first step is to identify the stakeholder in the project. These parties are those that can influence public policy discussions and should be invited to participate in the process. The next step is to develop a charter for the organization. The charter should identify roles and relationships of the participants as well as dispute resolution processes and goal setting procedures. Now that the stakeholders are identified and a charter ratified, the organization structure for the project can be established. The organization's purpose is to assist decision makers navigate the potential barriers to successful development and completion of projects. These relationships provide the technical and financial support for the policy makers to understand and make decisions on public projects.

This method is especially useful in the municipality and PWD interface. The PWD provides the technical expertise and construction project management knowledge to advise the city or county commissioners make decision on current or upcoming construction projects.

5.3 Internal Conflict Resolution

The organizational structure of a public works department can vary from one organization to another depending upon its current and past administration. Chapter Three outlined the organization structure for the Dallas County Public Works Department. Within the Dallas County PWD Anderson and Back observed that there was a low level of debate and disagreement between the PWD employees and division. This is likely the typical scenario in any public agency, Singh and Johnson (1998) observe the same scenario in the state public works agency they studied. Several factors can contribute to this occurrence and are likely difficult to resolve. One of these factors is the

management regulation placed upon the PWD. Most public agency chapters and organizational regulations are written to dispel any debate and conflict within the agency. Many of the positions are occupied by the same person for years, and the relationships between the divisions become stagnant.

In contract to external relationships, internal conflict is often dysfunctional due to lack of stimulation. Meaning that the conflict level is too low. To increase the level of conflict within the public works department some management process and tools can be introduced or redesigned to stimulate debate. Two possible methods are the constructability review process and fabricated organizational structures.

5.3.1 Constructibility Review

Primarily a design tool, constructibility reviews can also be used to increase the interaction between groups or agencies. The purpose of the constructibility review is to minimize contractual disputes and conflict during the construction phase of a project. To achieve this several organizations need to review the contract documents for scope accuracy, clarity of terms and clauses, design deficiencies, and general construction practice standards.

Constructibility can be defined as the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives (*Constructibility* 1986). The constructibility review may be performed at various times during the planning, design, and construction of the project, but the early integration of a constructibility review facilitates maximum benefits for the project. This allows the planners and designers to make changes to the contract drawings before follow-on work begins.

During the course of the constructibility review process, the project manager must coordinate with the owner or owner's agent, design consultant, utility companies, environmental regulators, and possibly the contractor. This process improves the lines of communication and further familiarizes the project manager with each of the participants. The current draft of the contract documents must be distributed for review and return of comments. As each participant provides their review comments they feel as if they are involved in the project and have some constructive input on the development of the contract documents. A successful constructibility review can set the stage early for positive relationships with the cities, designers, contractor, and other agencies.

A formal constructability review process does no appear to exist within the Dallas County PWD. The process diagrams by Anderson and Back annotates constructibility reviews as only an input to a couple of activities. The establishment of a formal constructability review process would potentially increase the conflict within the agency by increasing the interaction between the divisions. The division would conduct the constructibility reviews during the design and construction phases of project management and provide input for consolidation by the Project Engineer. During the course of this review the division should generate debate over ideas and differing points of view. These debates would increase the productivity and development of innovative ideas.

To fully develop the constructibility of a project a shift from review-driven constructibility practices to more continuous application of constructibility review concepts and ideas during planning and design must be considered (Anderson, Fisher, and Rahman 1999). This will allow for improved relationships with contractors and designers during the construction phase by identifying potential problems prior to their

occurrence. Substantially reducing the possibility for disruption in the construction progress and development of unfavorable relationships.

5.3.2 Fabricated Organizational Structures

The Fabricated Organizational Structures (FOS) concept was discussed earlier as a tool to resolve intergroup conflict between the PWD and the city and county commissioners, but it can also be used to resolve intragroup conflict. In a sense the Project Engineers and designers are the technical experts, while the PWD Director is the public figure making decision on public projects. Using this scenario, the FOS concept can be employed within the public works department.

5.4 Summary

In this chapter, potential interaction management tools to be used by public works departments for resolution of external and internal conflict were discussed. Partnering is currently used in the public and private sectors, and is commonly used on public construction projects with great success (Rock 1992; Daigle and Touran 1998). By establishing these partnering relationships and setting a means to measure the success of the partnership, a public works department can improve the level of interaction with the other participants of the partnership and better manage the conflict levels between the agencies. Constructibility review and Fabricated Organizational Structures are also helpful tools in mastering the numerous internal interfaces of the PWD. These tools provide focus on areas other aspects of the project management, but both provide valuable insight into the intragroup and intergroup interactions of the public works department.

Chapter 6: Summary

The purposes of this report was to present a discussion on the challenges in the management of the multiple interactions of a Public Works Department. To develop the framework for this discussion, several objectives were established early in the report. A review of these objective includes identifying internal and external interfaces related to project management, identify management tools which assist in these interfaces, and evaluate how conflict affects the effectiveness of the organization. These objectives were discussed in detail in chapter 3 through chapter 5.

The Dallas County Public Works Department was used to determine the types and purpose of the many relationship established during the project management process. The interactions at the Dallas County Public Works Department can be categorized as either internal or external interactions. The internal interactions are the intragroup relationships within the PWD. There are four major divisions in the Dallas County PWD, and their efforts are coordinated by the project engineer during the project management process. These relationships are required to develop and outline the project scopes, provide construction inspections, monitor the design process, and promote a partnering relationship. These relationships exist over the course of four general categories of project management. These categories were determined to be planning, pre-design, design, and construction. Many external interactions also exist at the PWD. The PWD is required to coordinate with municipalities, utility companies, schools, and many other agencies in the project management cycle.

During the course of these many interactions with lateral division in the PWD and external agencies, organization conflict is destine to occur. Chapter 4 discussed the

benefits of conflict within the "group" and methods of managing the level of conflict in an organization. This chapter discussed that conflict is not something to be avoided, but is necessary to promote new ideas and process changes. There are several methods of measuring conflict within an organization and it is important to monitor the amount of conflict in an organization. Even though conflict is good for instigating new ideas, it can also cause disruption in the process. Effective development and monitoring of conflict is critical of management success.

Interaction management tools are often effective at assisting the project manager or project engineer coordinate the combined efforts of all participants, and conflict resolution is obtained through this process. Partnering is used extensively in the private and public sectors to build trust and positive relationships between participants. Partnering is also a important part of the Dallas County PWD's project management process. Other management tools were determined to be constructibility reviews and Fabricated Organizational Structures.

Chapter 7: Conclusion

Public Works Departments are highly dynamic organizations with a tremendous amount of interface with other government agencies and private corporations. The frequency and purpose of these many interactions was based upon the case study performed by Anderson and Back on the Dallas County Public Works Department in November 1997. The PWD's ability to successfully manage and direct these interactions is a direct indicator of the potential success of design and construction projects. From the research, there is a stark void in the number of journals and articles discussing the organization and responsibilities of the PWD. The American Public Works Association did publish a special report in 1970 outlining the different organizational structures of several public work departments. However, this report is quite dated and needs to be updated.

There is great deal to learn on the extent and number of interfaces that a PWD is required to manage during the project management process, and the significance of each interaction. With a more in-depth study of these interactions, an interaction model could be developed to assist the various PWD manage their many interfaces with external agencies. One method would be to use IDEF0 modeling techniques to model and illustrate the interfaces associated with each project management activity. The Project Engineers could then consult the model to determine appropriate interfaces for the many project management activities and better plan upcoming events.

The benefits of conflict were also found to be very interesting, as was the discussion on the development of conflict in the organization. The common thought process is to avoid conflict and disruption, however, several articles supported that

conflict must be generated within the organization to motivate personnel to develop new viewpoints and perspectives. Public works agencies typically have low internal conflict levels that require stimulation to obtain functional conflict levels. At the same time, the intergroup conflict is sometimes very high and resolution techniques such as smoothing and compromise must be employed to reduce the conflict to a functional level.

At the Dallas County Public Works Department there are several possible methods to potentially improve the quality of public works department interactions, both internally and externally. The PWD should seek to diversify their personnel. People from different backgrounds and careers form different opinions and increase the innovative thinking of an organization. The PWD should strive to increase internal conflict. This stimulated debate and increased discussion on critical issues, possibly formulating an idea than no one would have determined otherwise. In contrast, many of the interfaces with construction contractors, design consultants, and franchise utility companies includes high conflict levels and require conflict reducing techniques. Relationships with contractors and designers are very structured and are formally controlled by construction contracts and engineering service agreements. However, the relationships with the franchise utility companies are not governed by any formalized agreement. The PWD needs to establish an agreement vehicle with the franchise utilities, such as Memorandum of Understanding or some other agreement method, to facilitate conflict resolution and improve the project management process.

The public works department should move to more non-traditional contracting strategies and employ partnering whenever possible. The partnering concept has been highly studied and proven to provide positive results. More PWDs should adopt this

concept to increase their effectiveness and the quality of their projects. The implementation of formal constructability review process should also be employed by public works departments. This would increase the quality of the projects through the extensive review process and increase the innovative thinking of the PWD personnel.

A public works department must establish trust and good lines of communication in all internal and external interfaces. By employing some management tools for interaction between agencies or within the PWD and use of conflict resolution techniques (smoothing, compromise, problem-solving, forcing, withdraw), the amount of dysfunctional conflict associated with a public works department should be drastically reduced and the productivity will increase.

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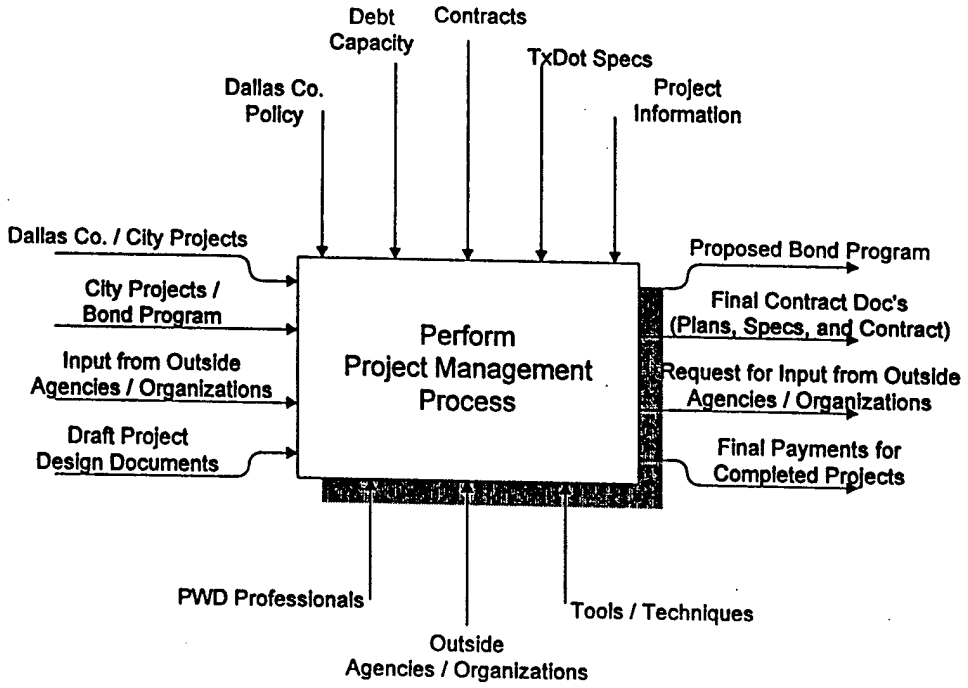
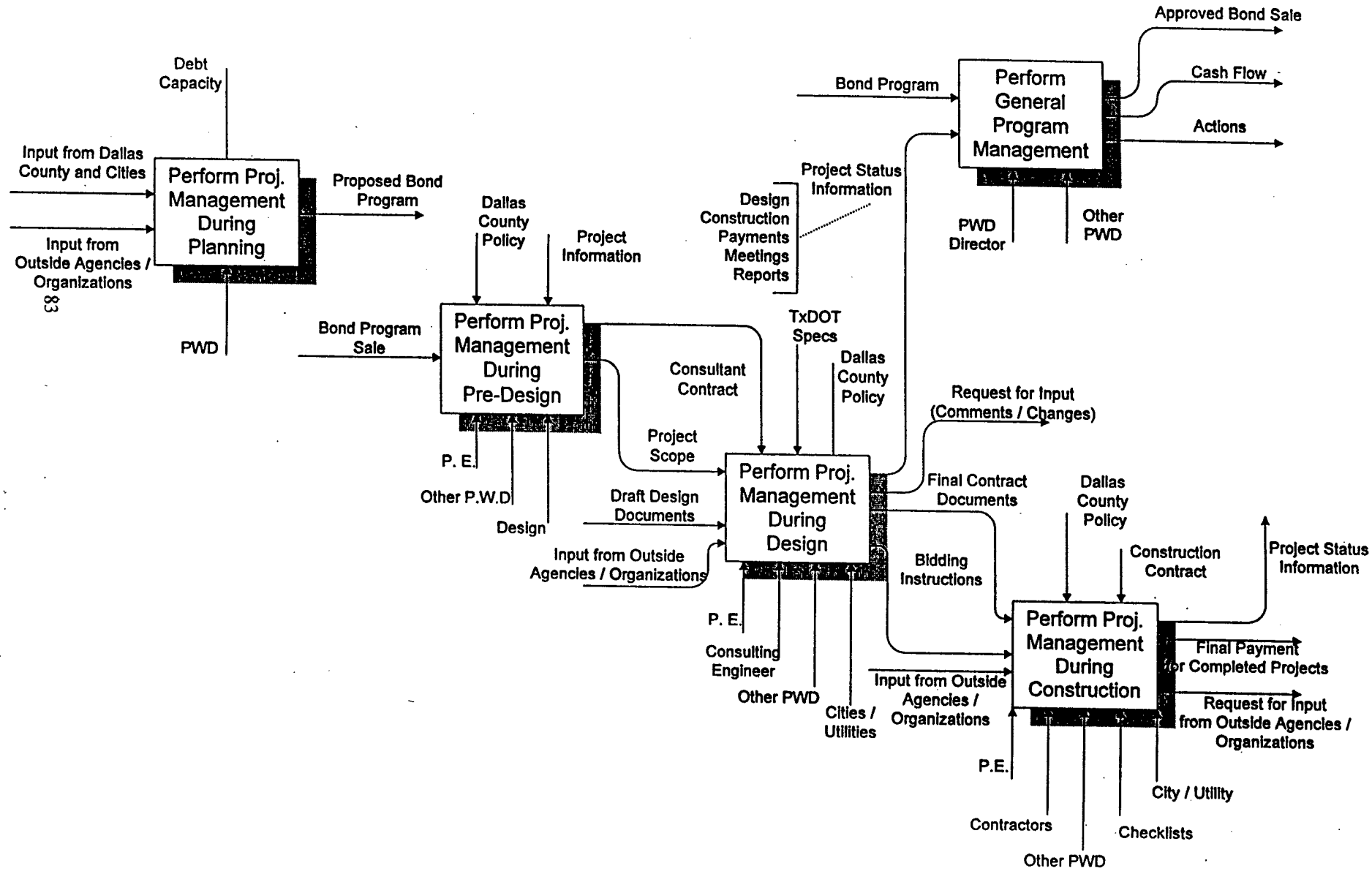
APPENDIX A

PERFORM PROJECT MANAGEMENT PROCESS DIAGRAMS

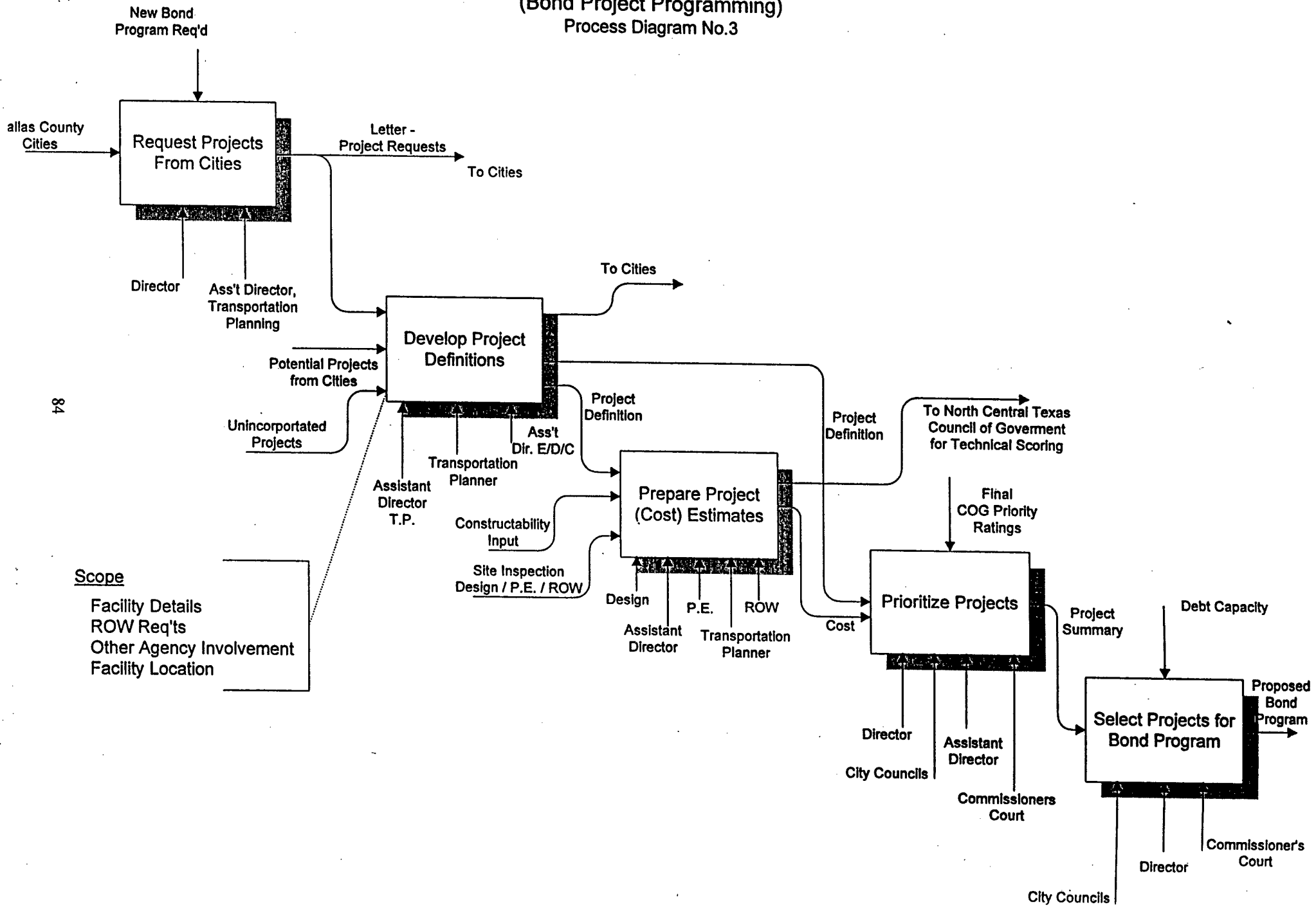
Perform Project Management Process
(Context Diagram)
Process Diagram No. 1



Major Project Management Activity Phases
(Perform Project Management for each Phase)
Process Diagram No. 2

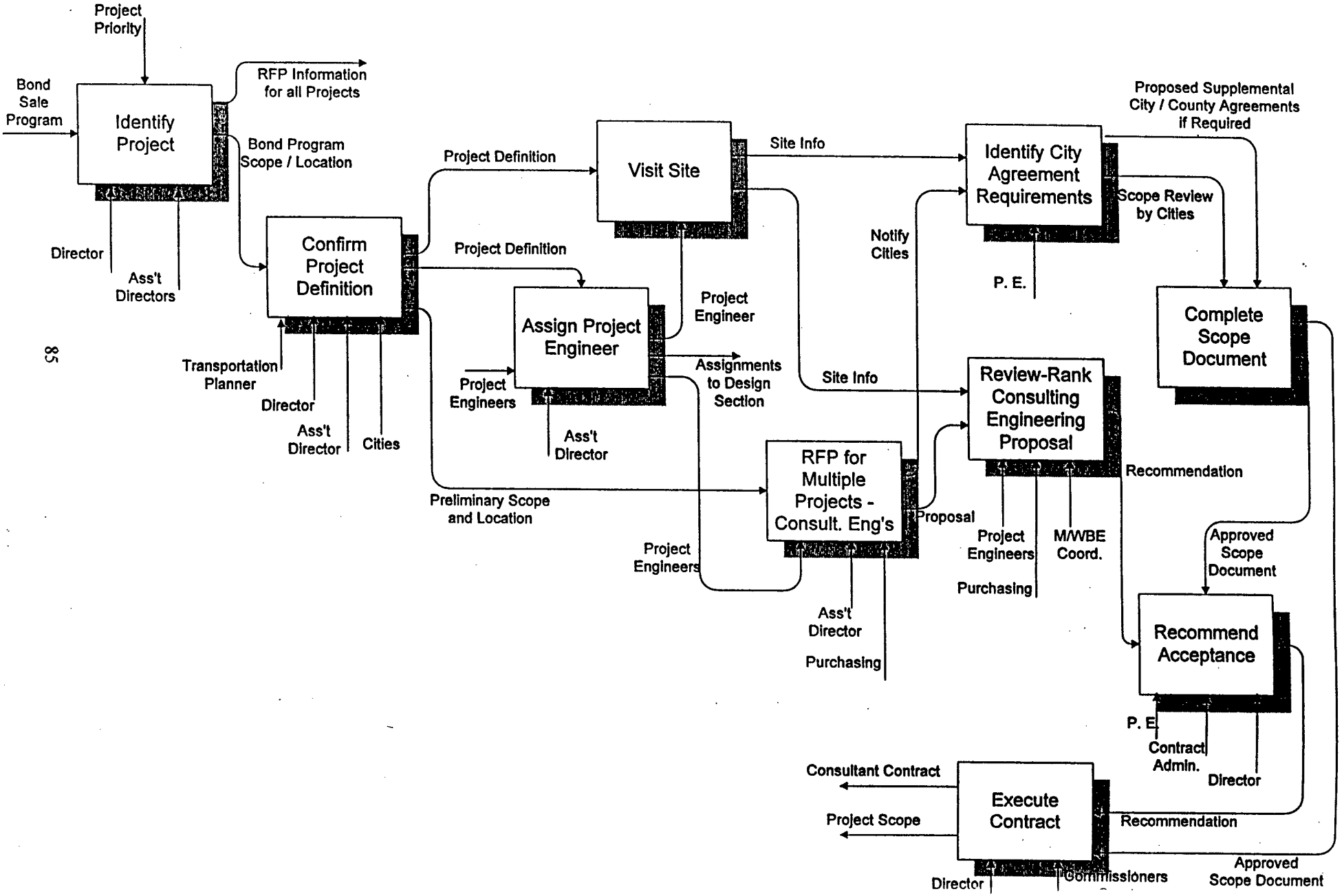


Project Management Activities During Planning
(Bond Project Programming)
Process Diagram No.3



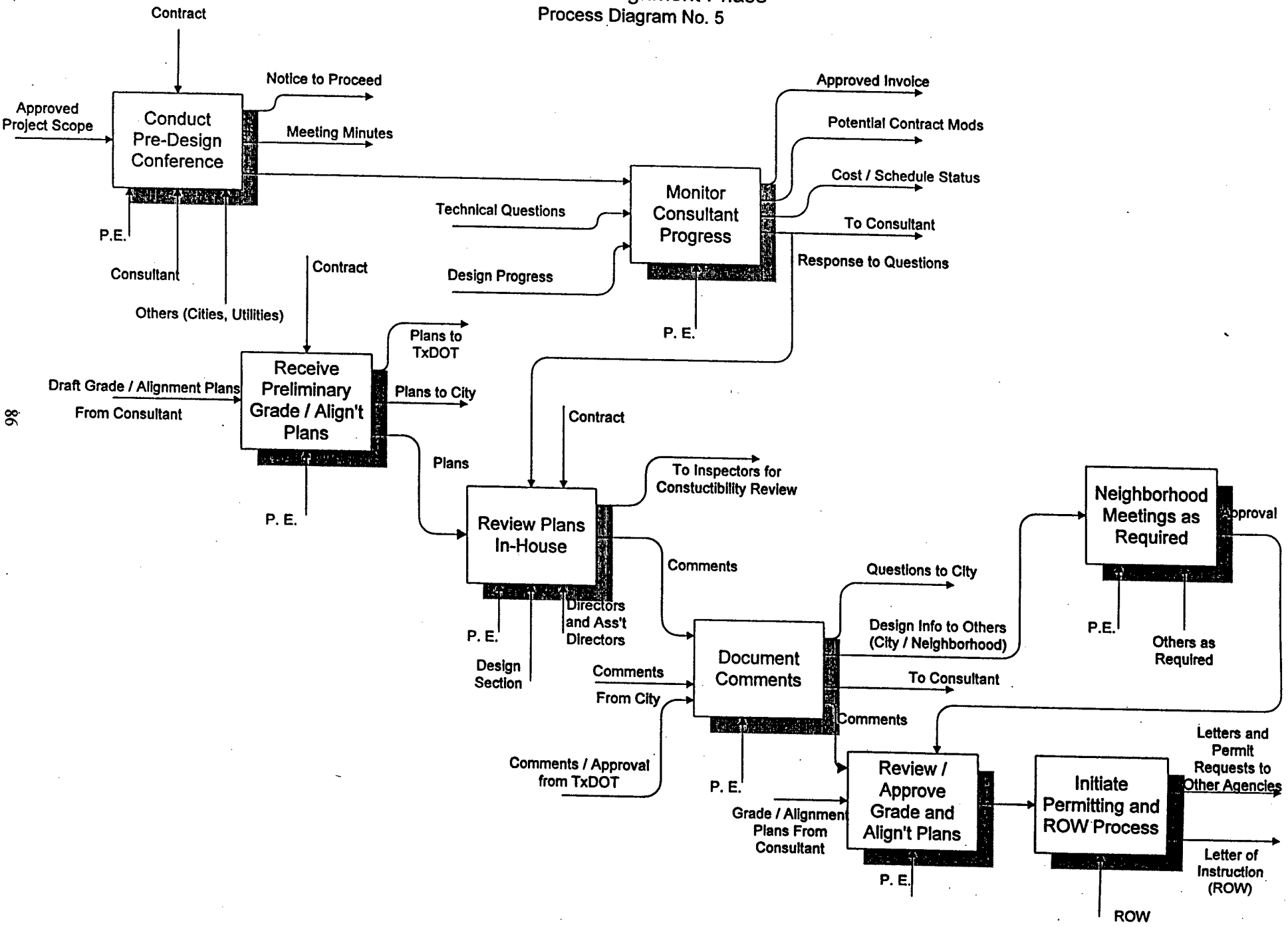
Project Management Activities During Project Initiation

Process Diagram No.4



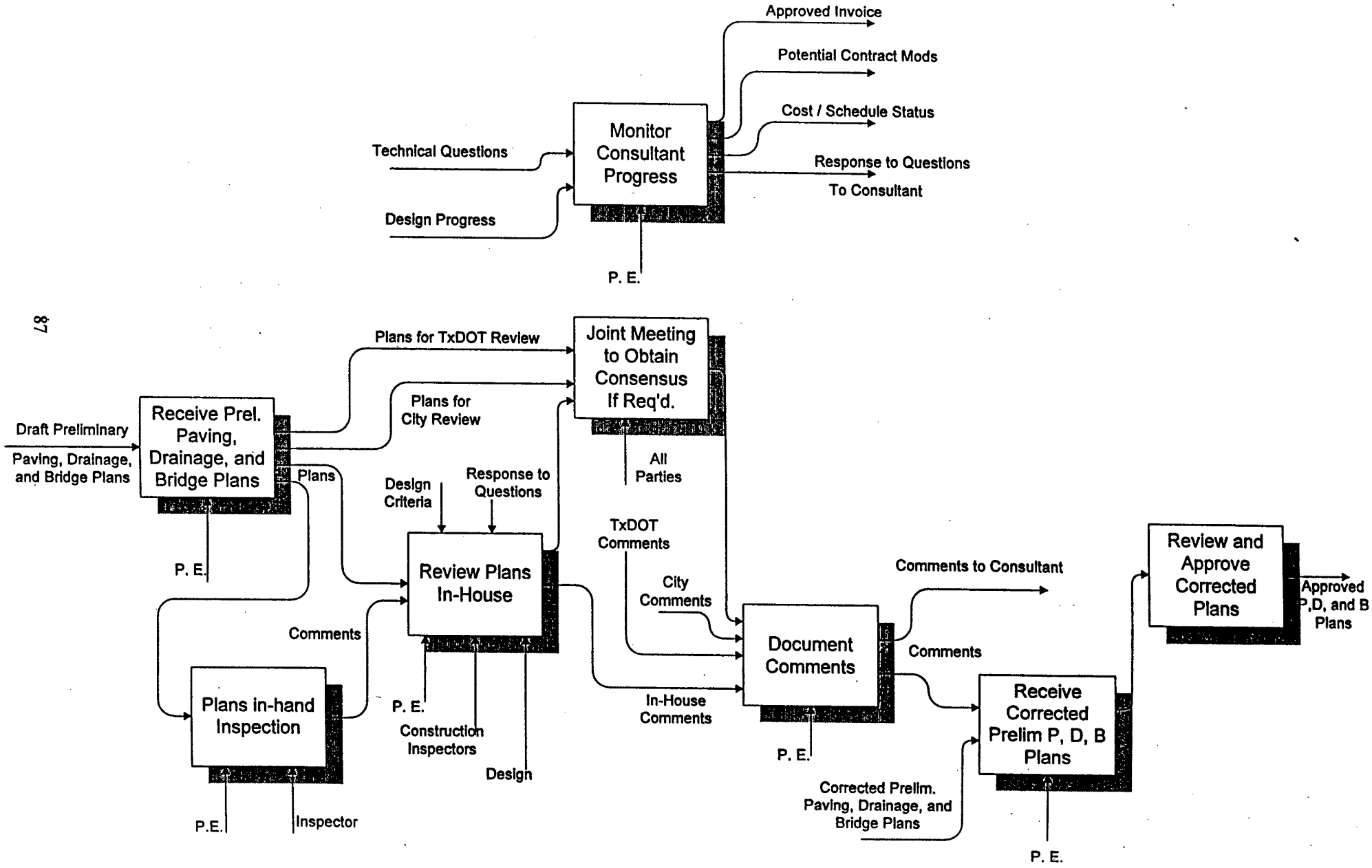
Project Management Activities During Grade and Alignment Phase

Process Diagram No. 5



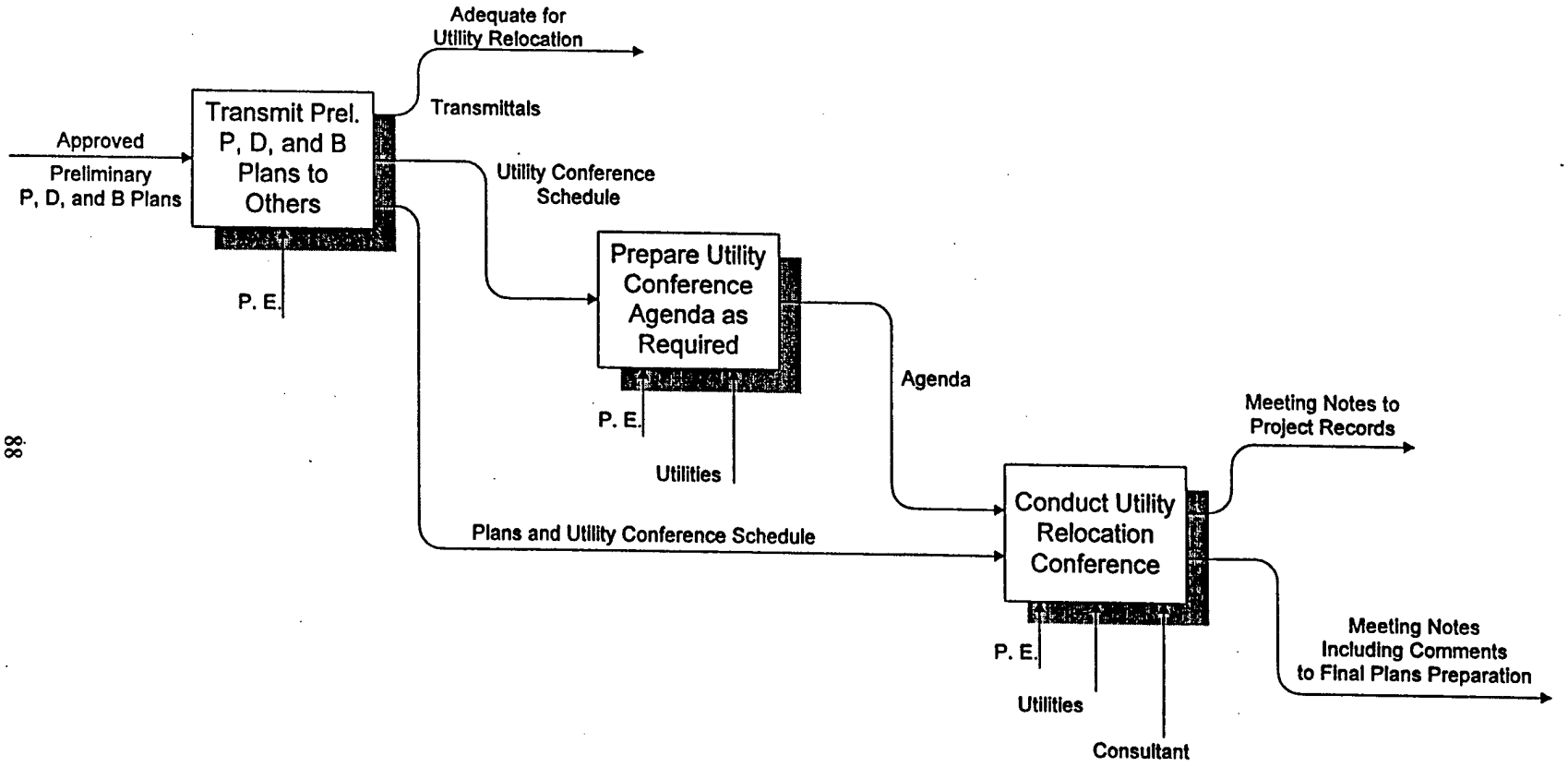
Project Management Activities During Preliminary Paving, Drainage, and/or Bridge Plan Preparation

Process Diagram No. 6



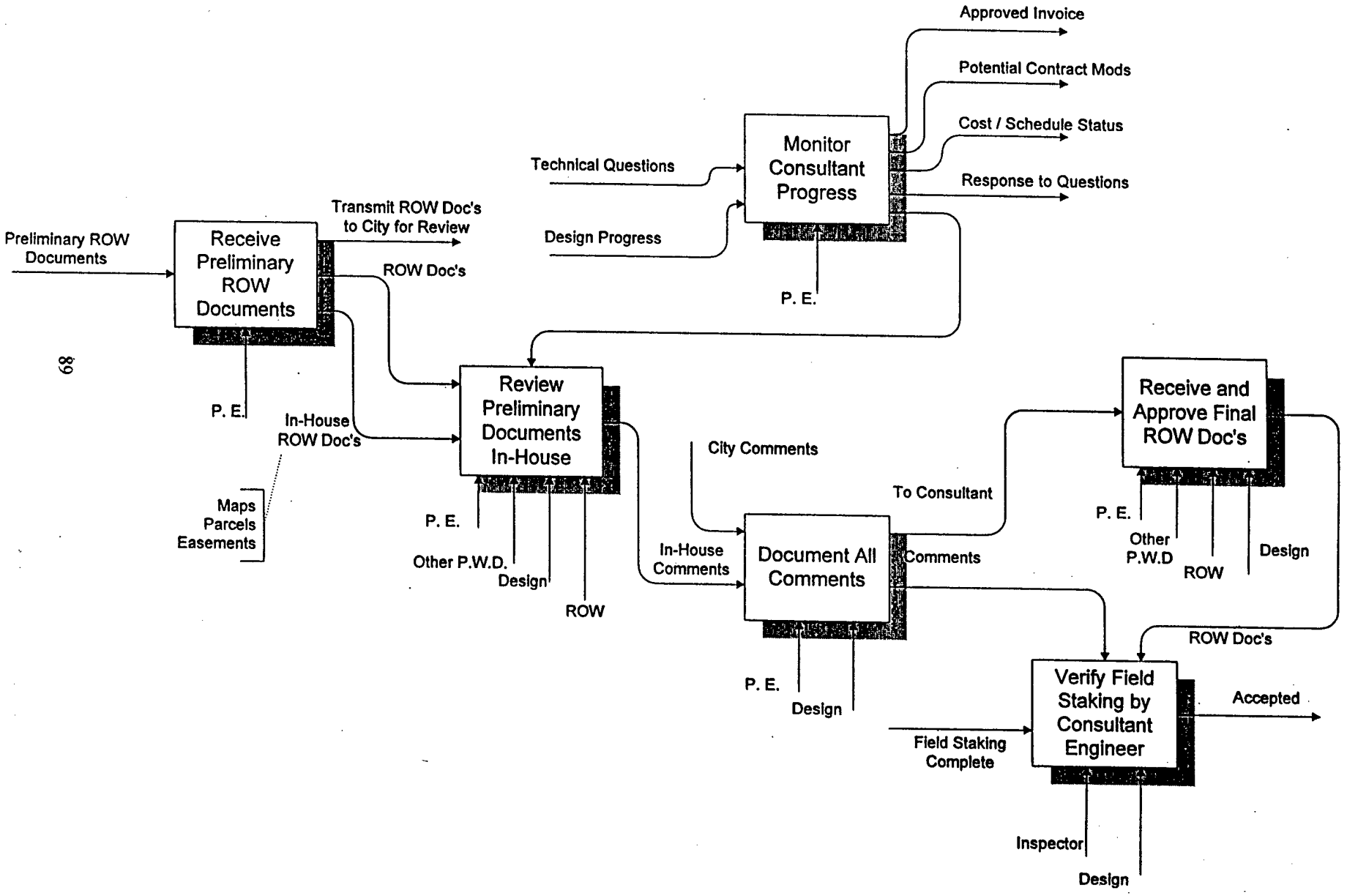
Project Management Activities During Preliminary Paving, Drainage and/or Bridge Plan Preparation

Process Diagram No. 7



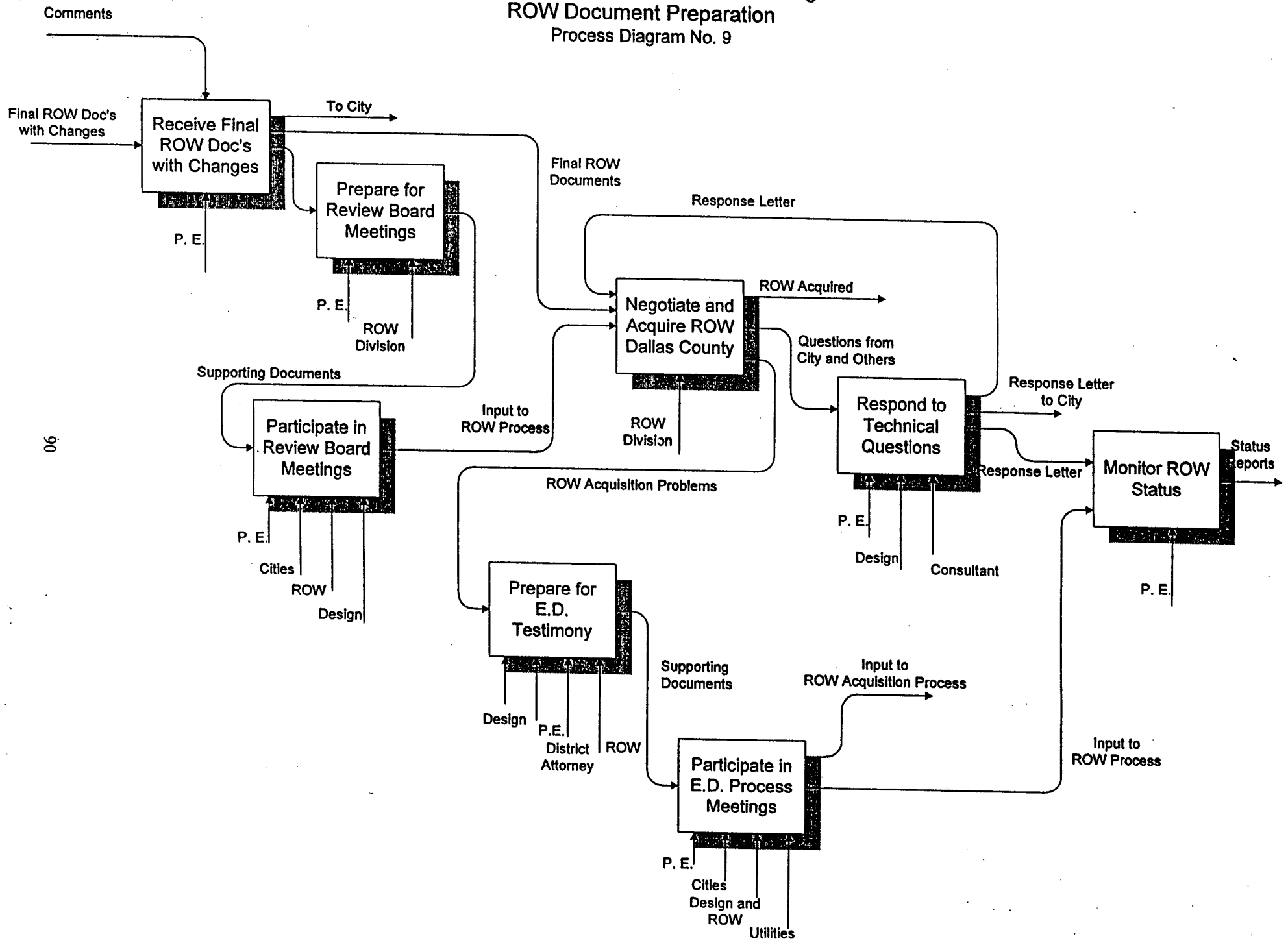
Project Management Activities During ROW Document Preparation

Process Diagram No. 8



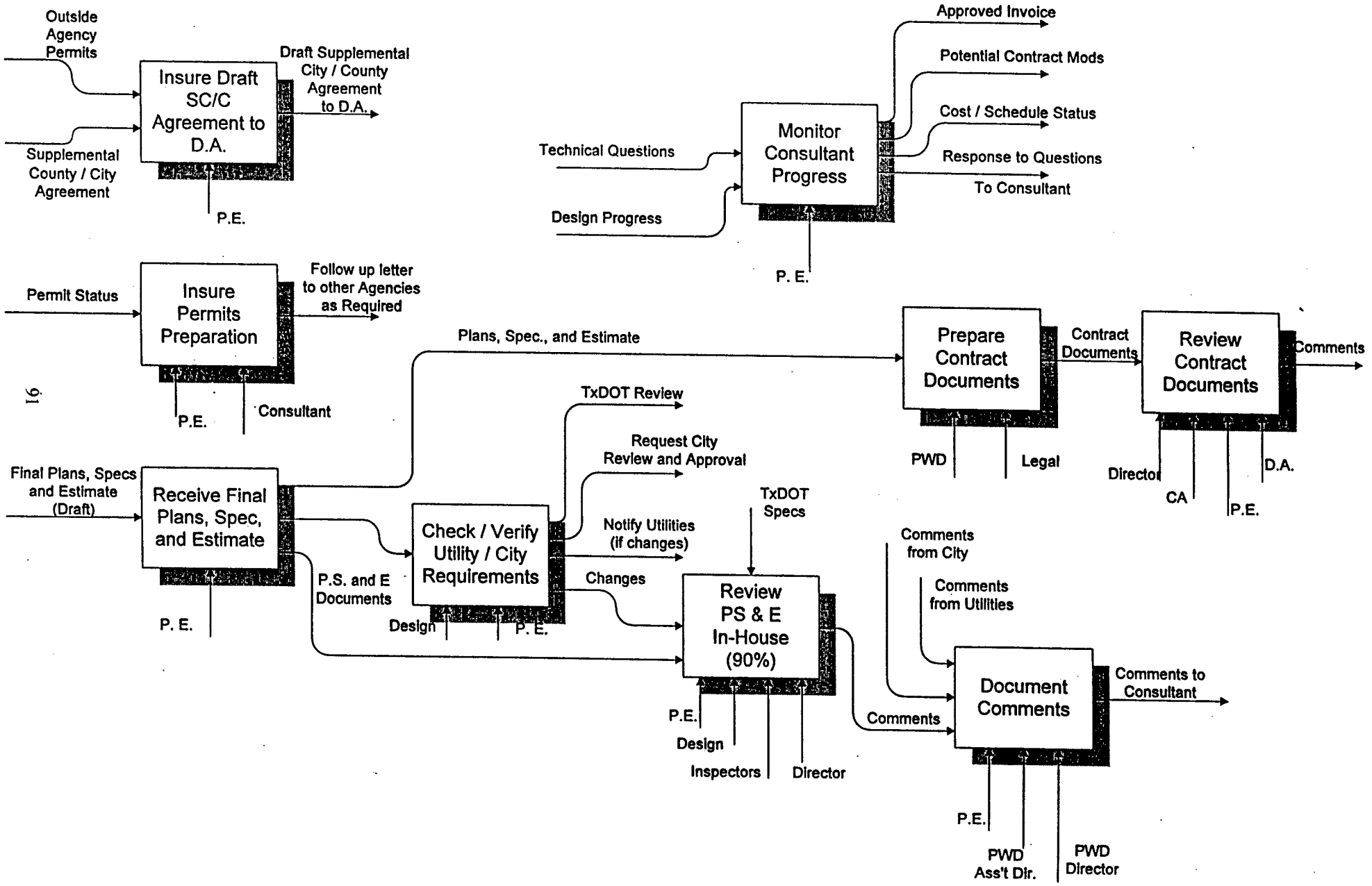
Project Management Activities During ROW Document Preparation

Process Diagram No. 9



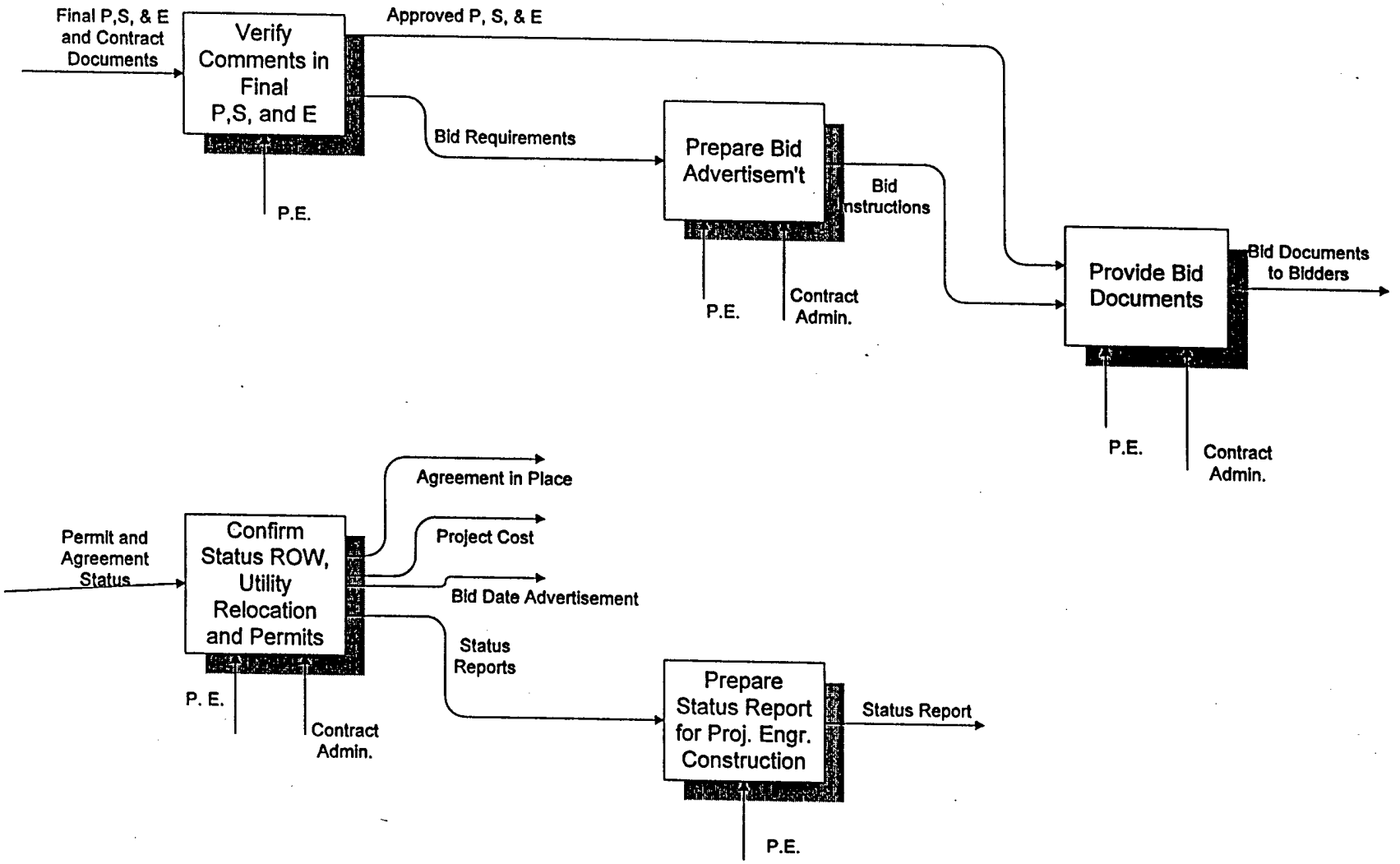
Project Management Activities During Final Plan Preparation / Completion

Process Diagram No.10

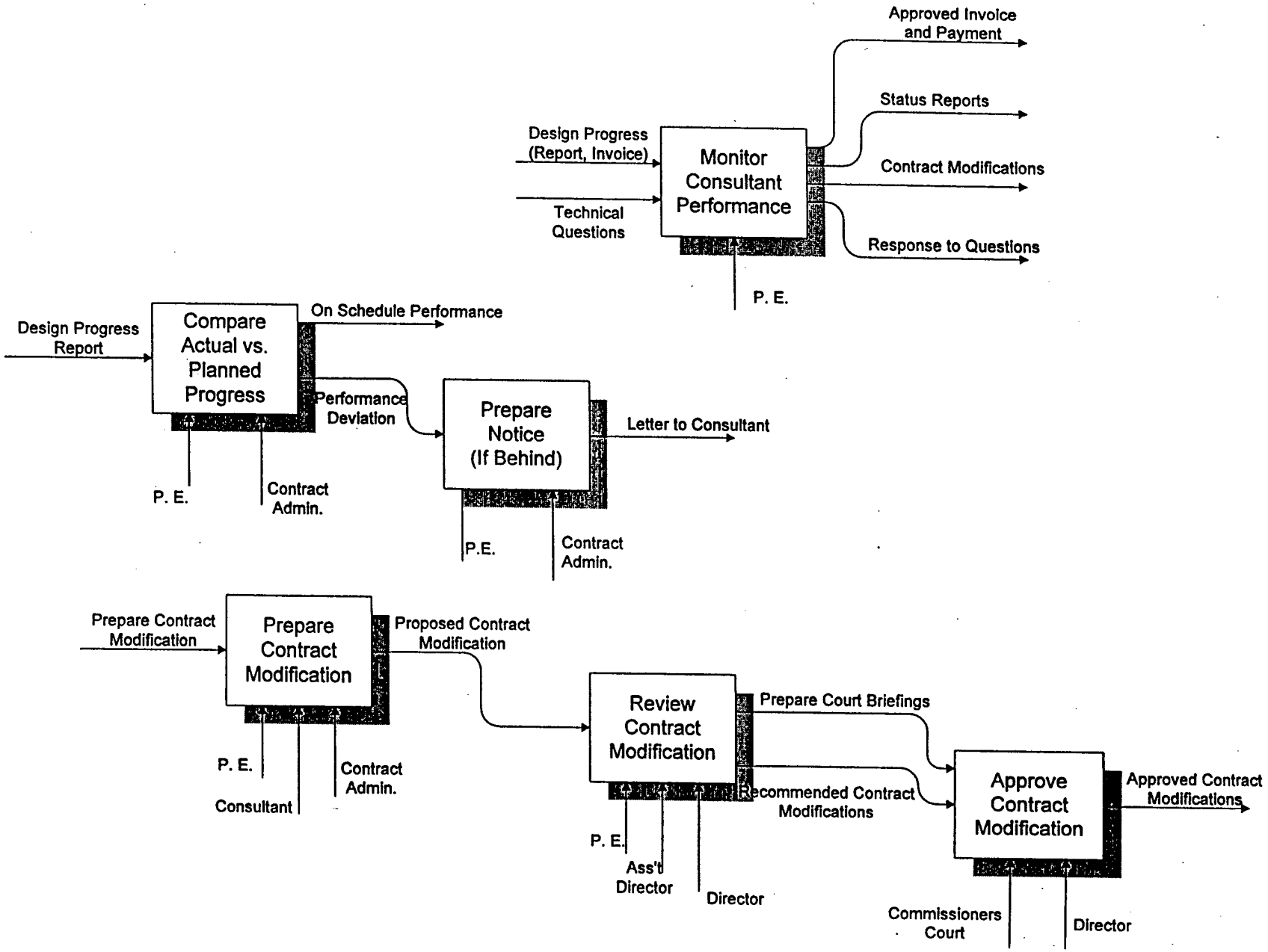


Project Management Activities During Final Plan Preparation and Completion

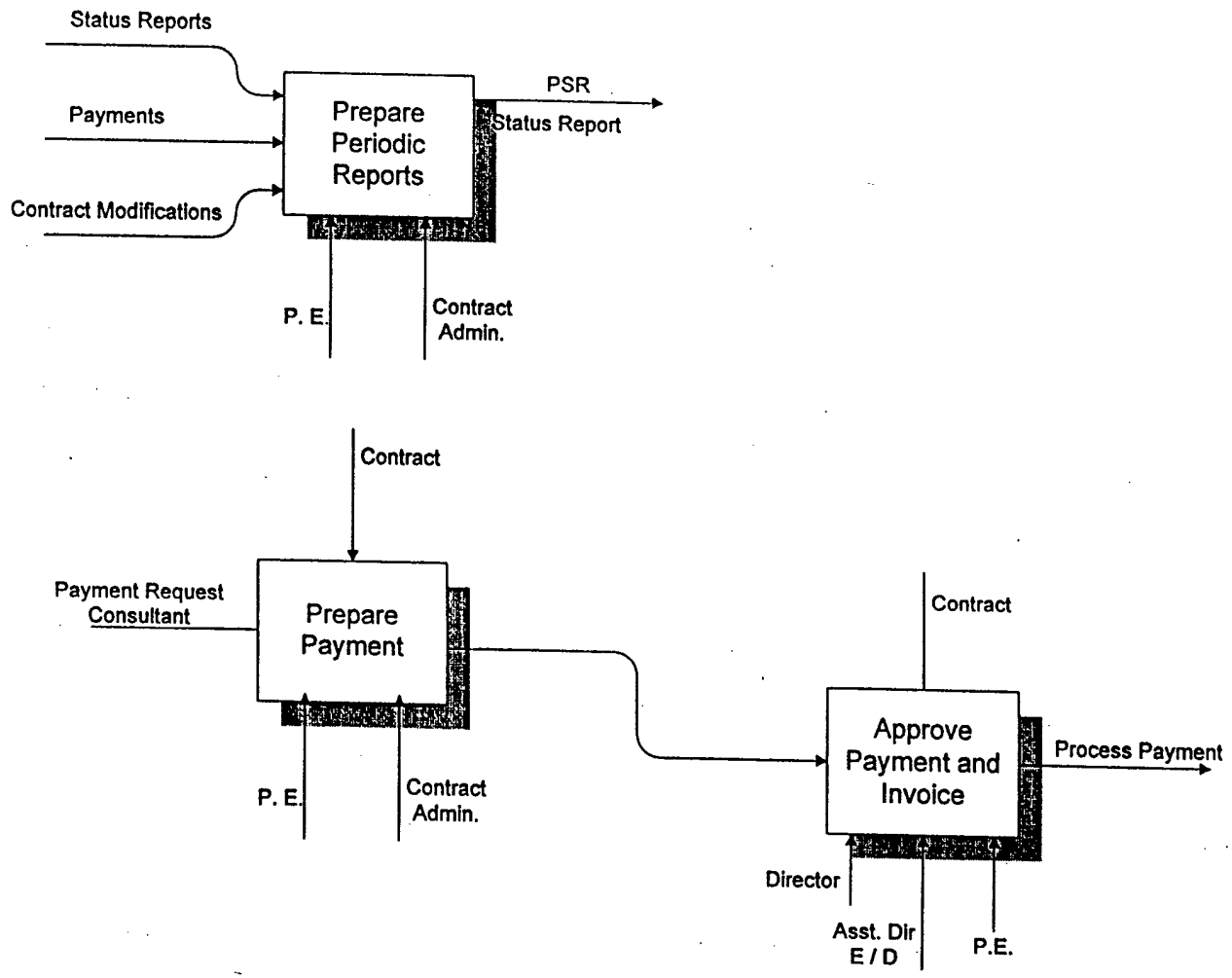
Process Diagram No. 11



Non-Sequential Project Management
Activities During Design
Process Diagram No. 12

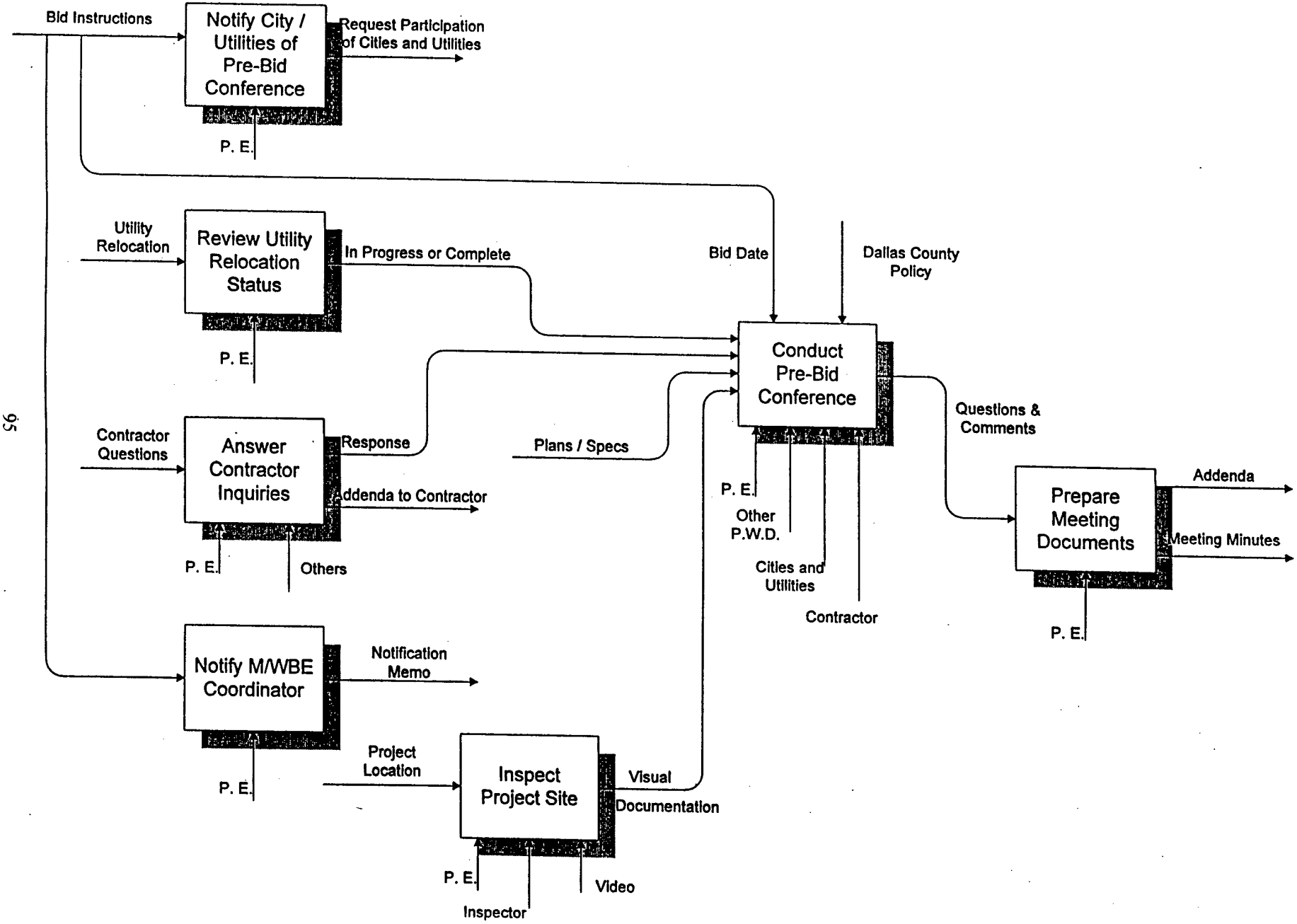


Non-Sequential Project Management
Activities During Design
Process Diagram No. 13



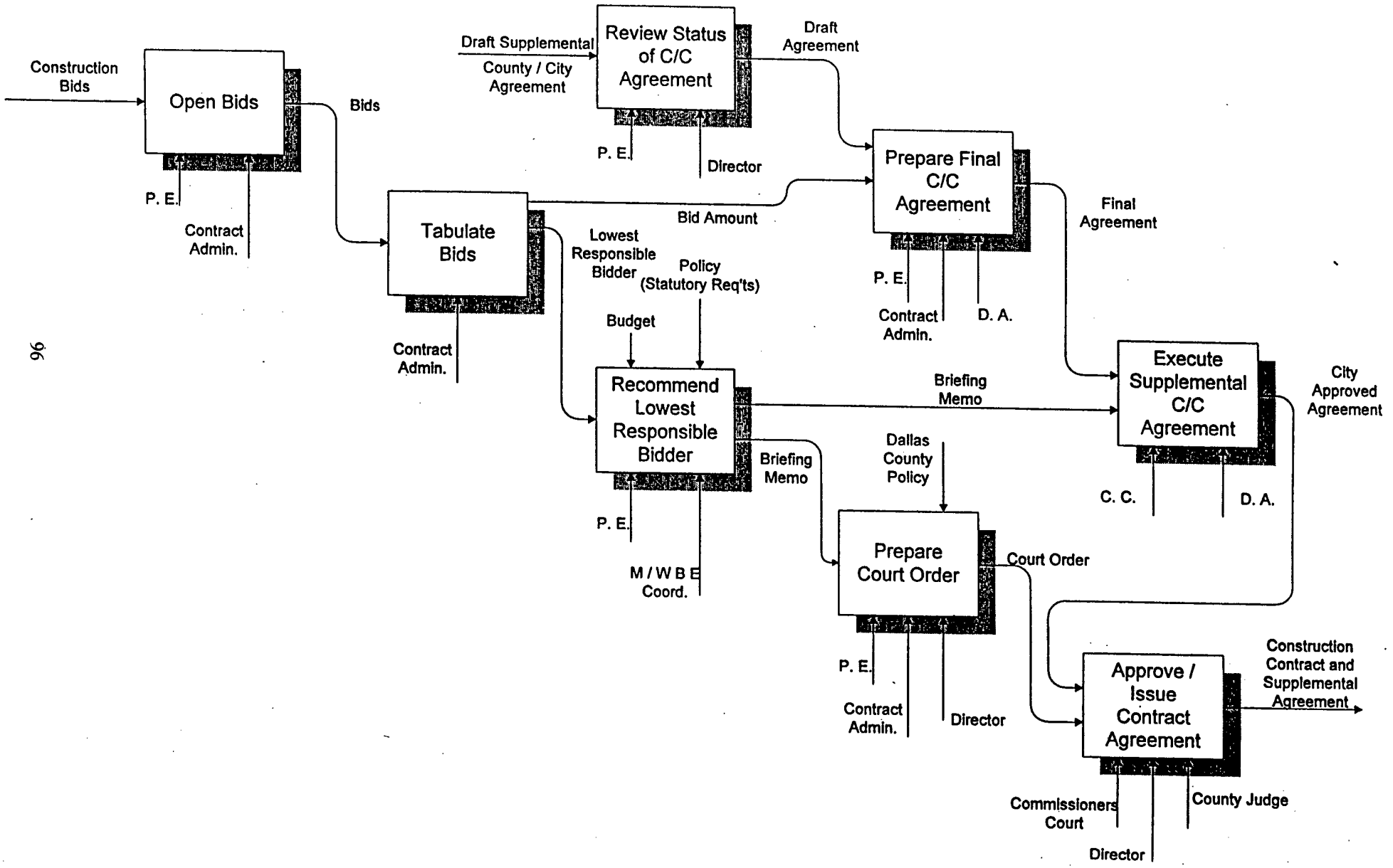
Project Management Activities During Pre-Construction

Process Diagram No. 14



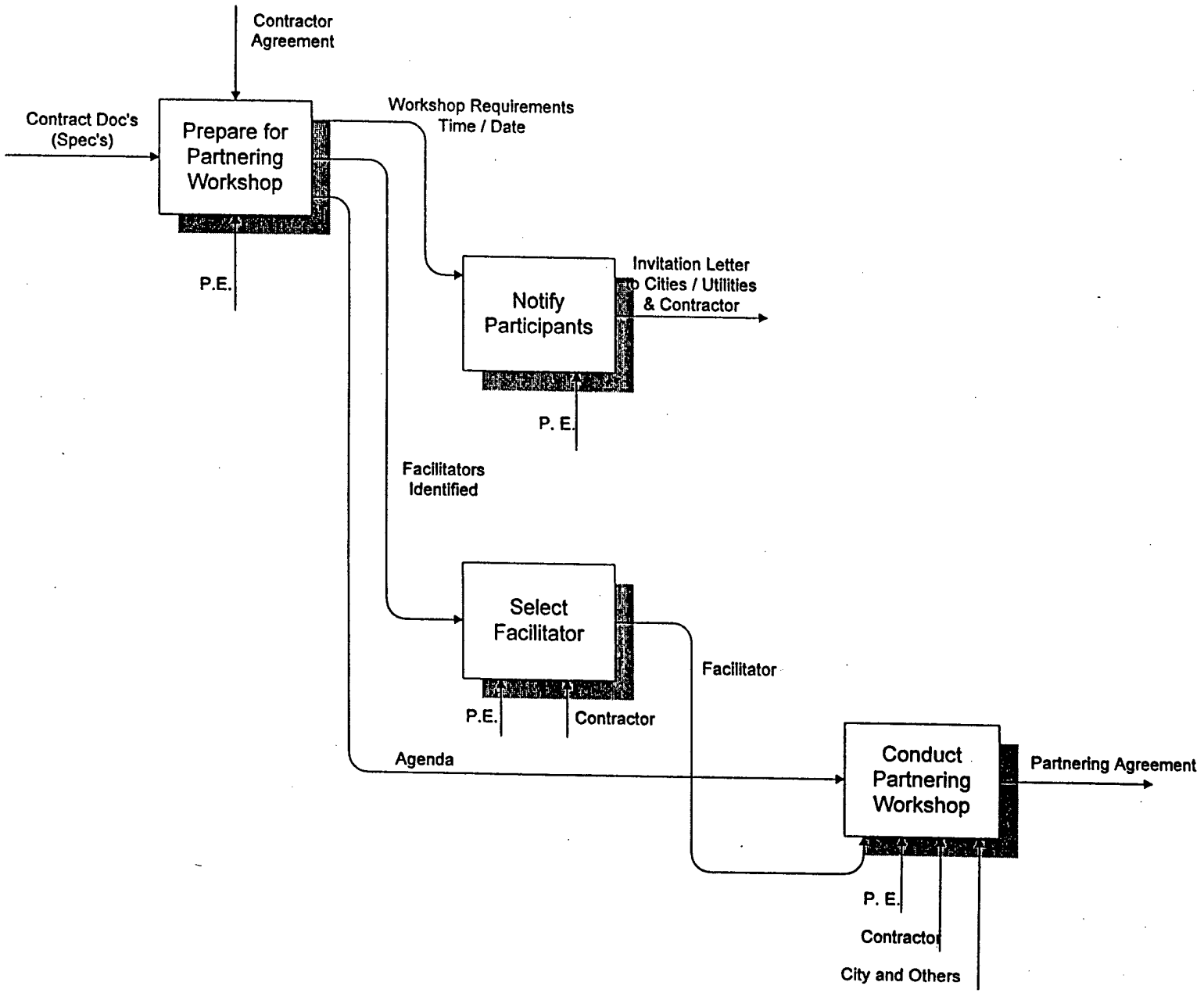
Project Management Activities During Pre-Construction

Process Diagram No. 15

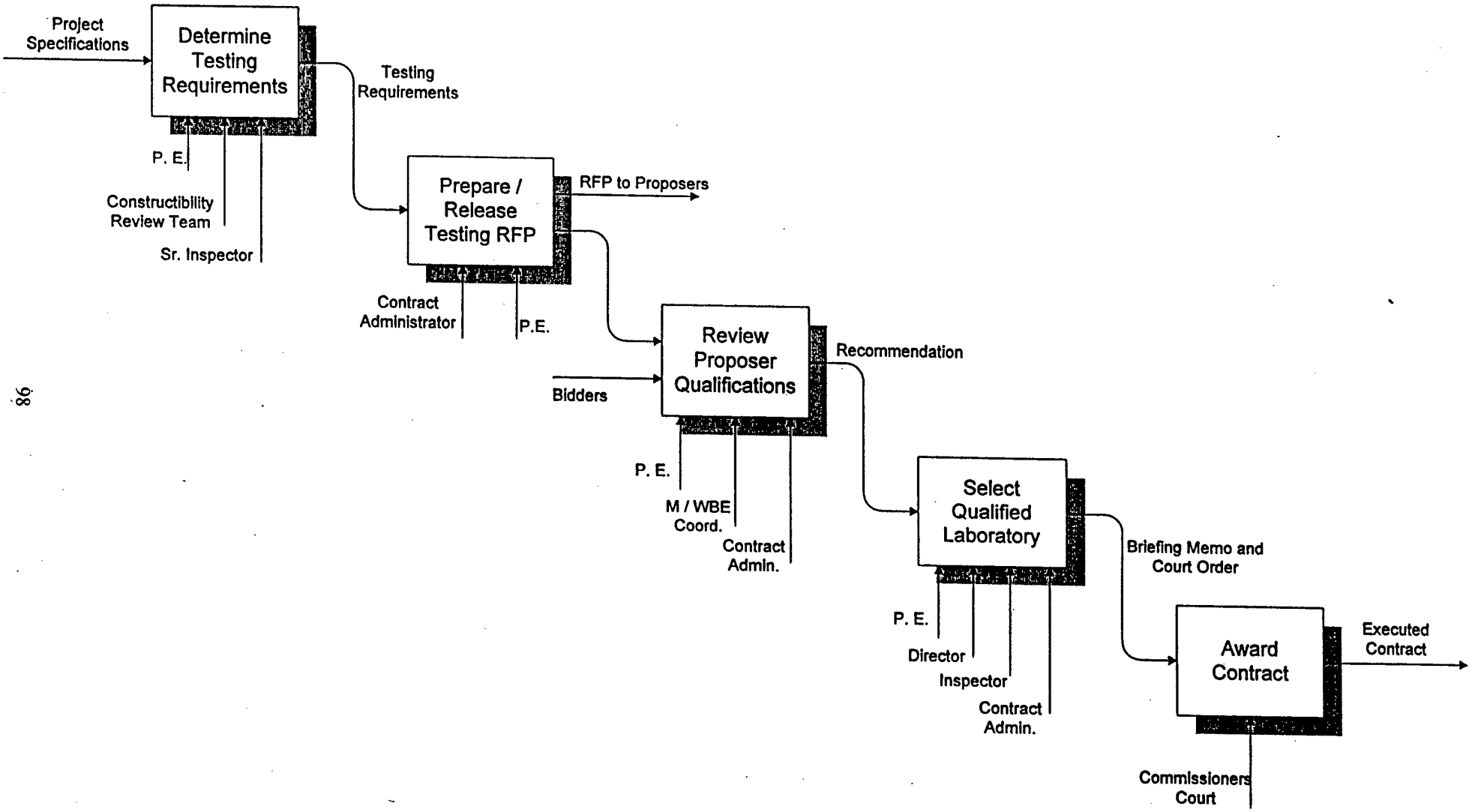


Project Management Activities During Pre-Construction

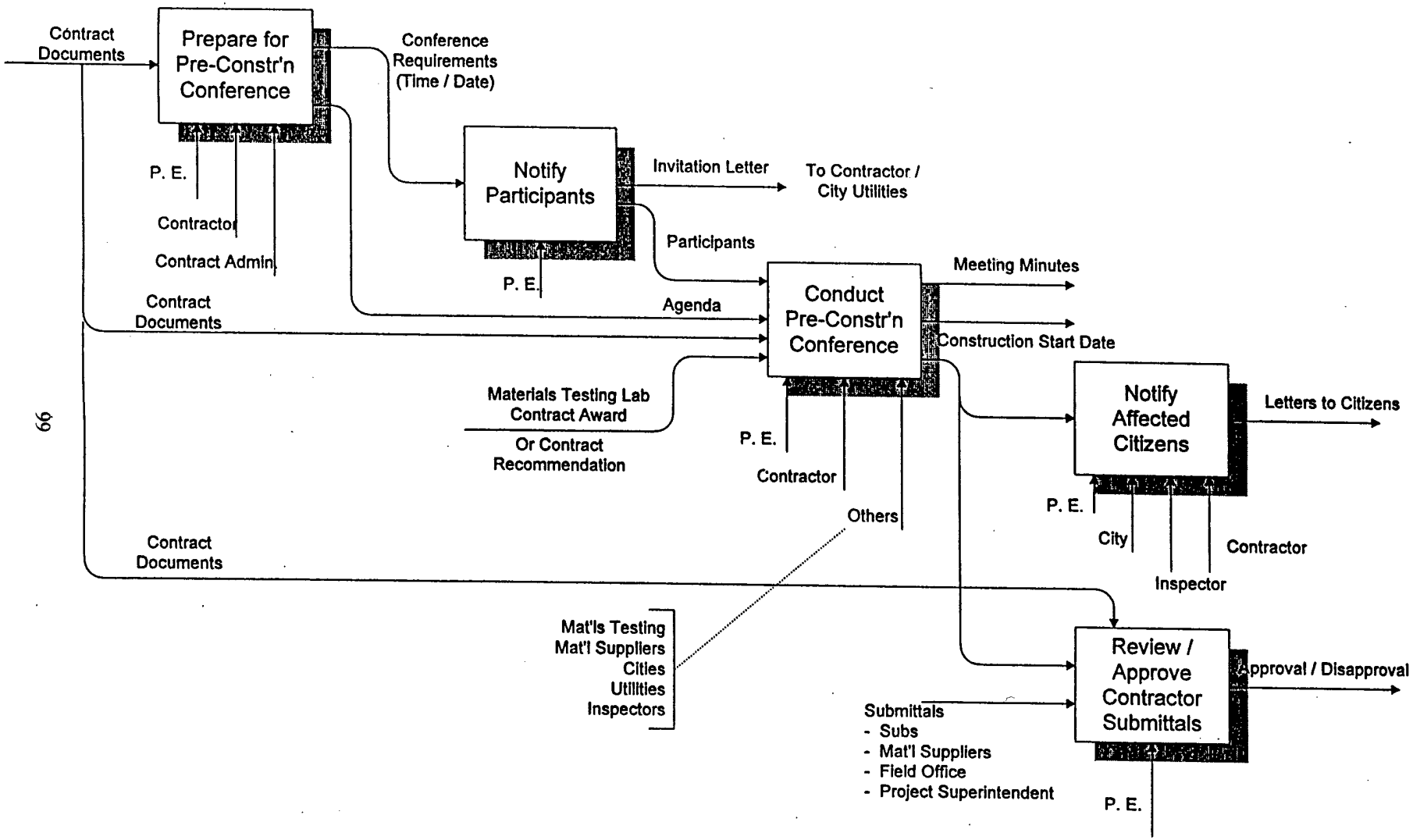
Process Diagram No. 16



Project Management Activities
During Pre-Construction
Process Diagram No. 17

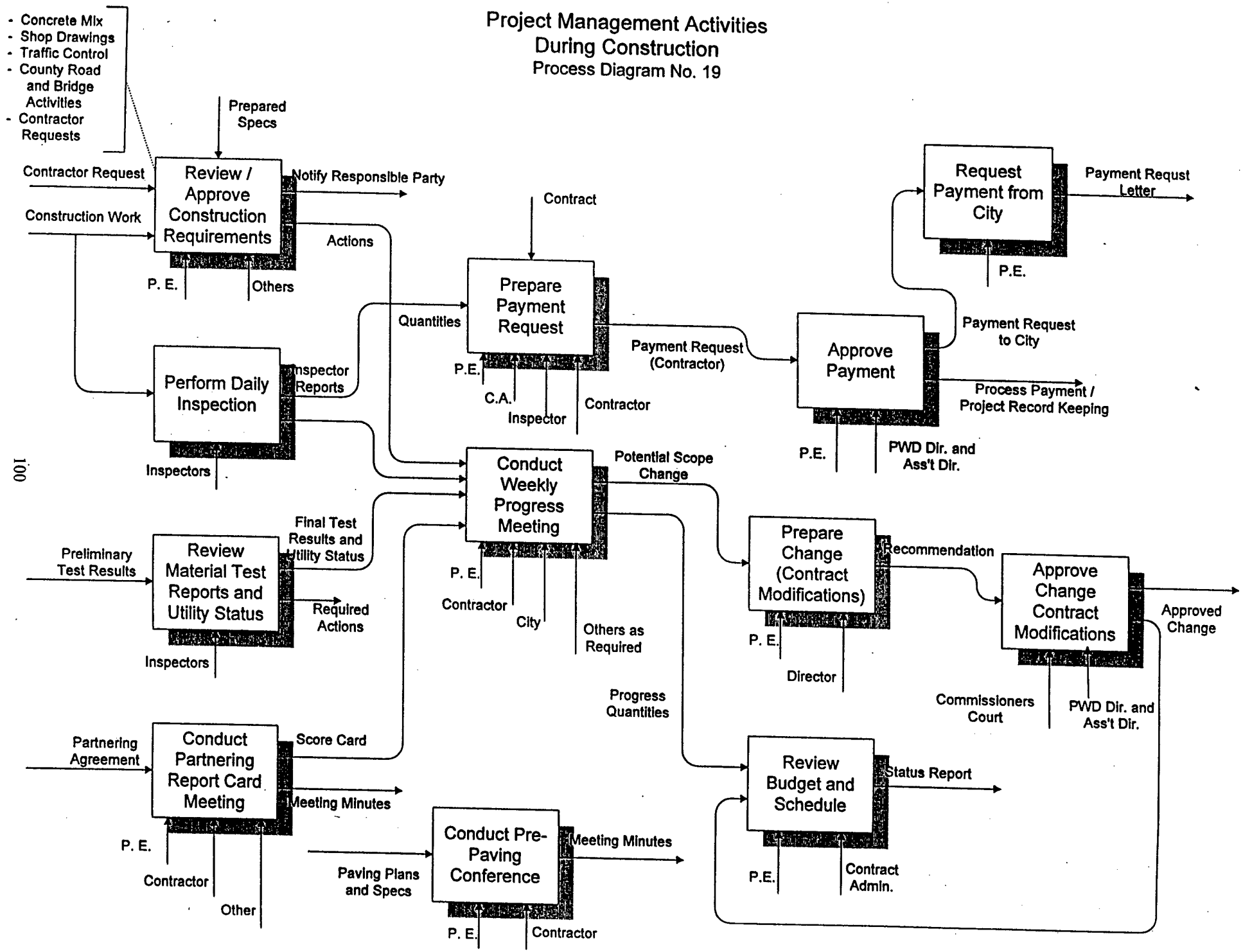


Project Management Activities
During Pre-Construction
Process Diagram No. 18



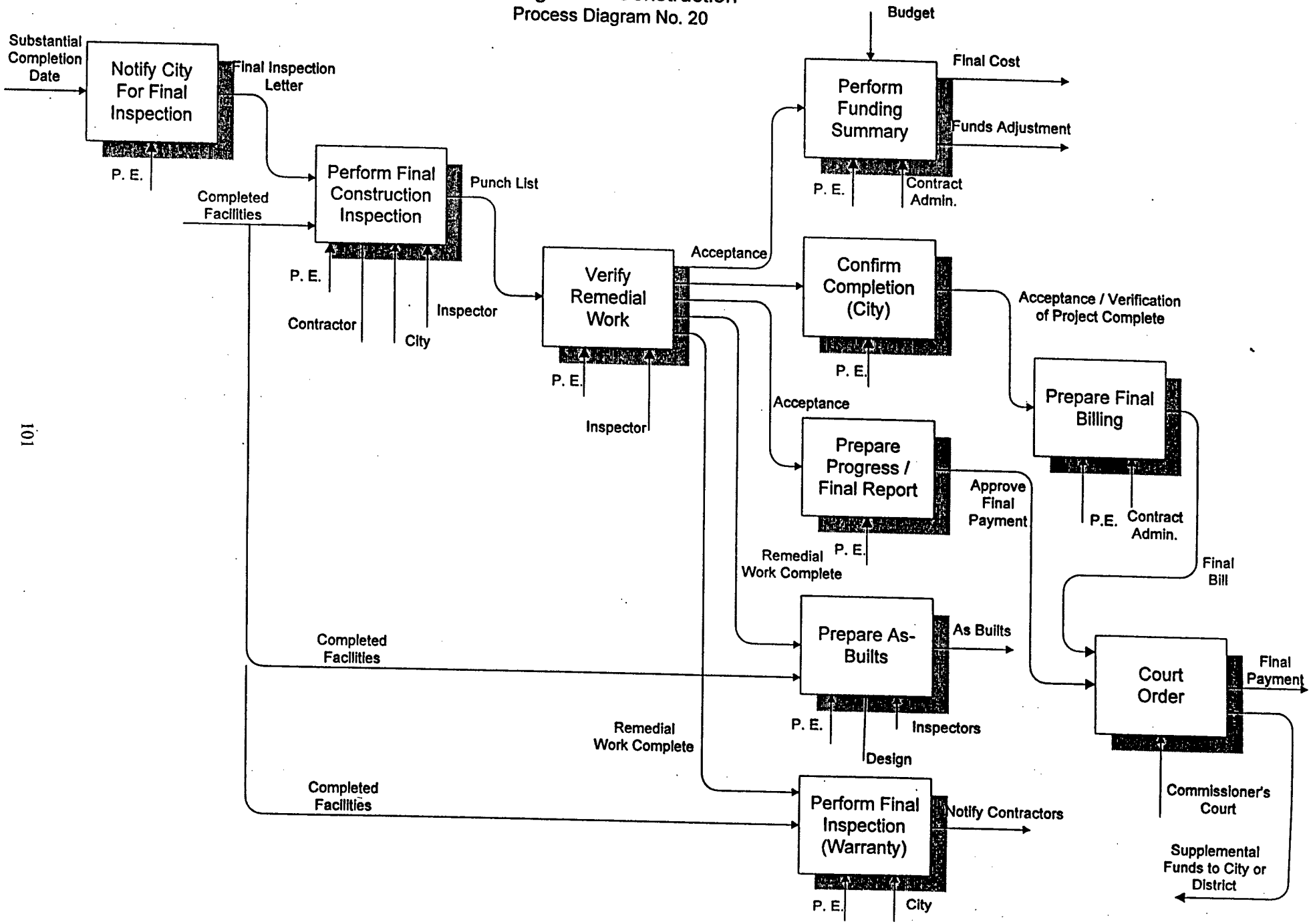
Project Management Activities During Construction

Process Diagram No. 19

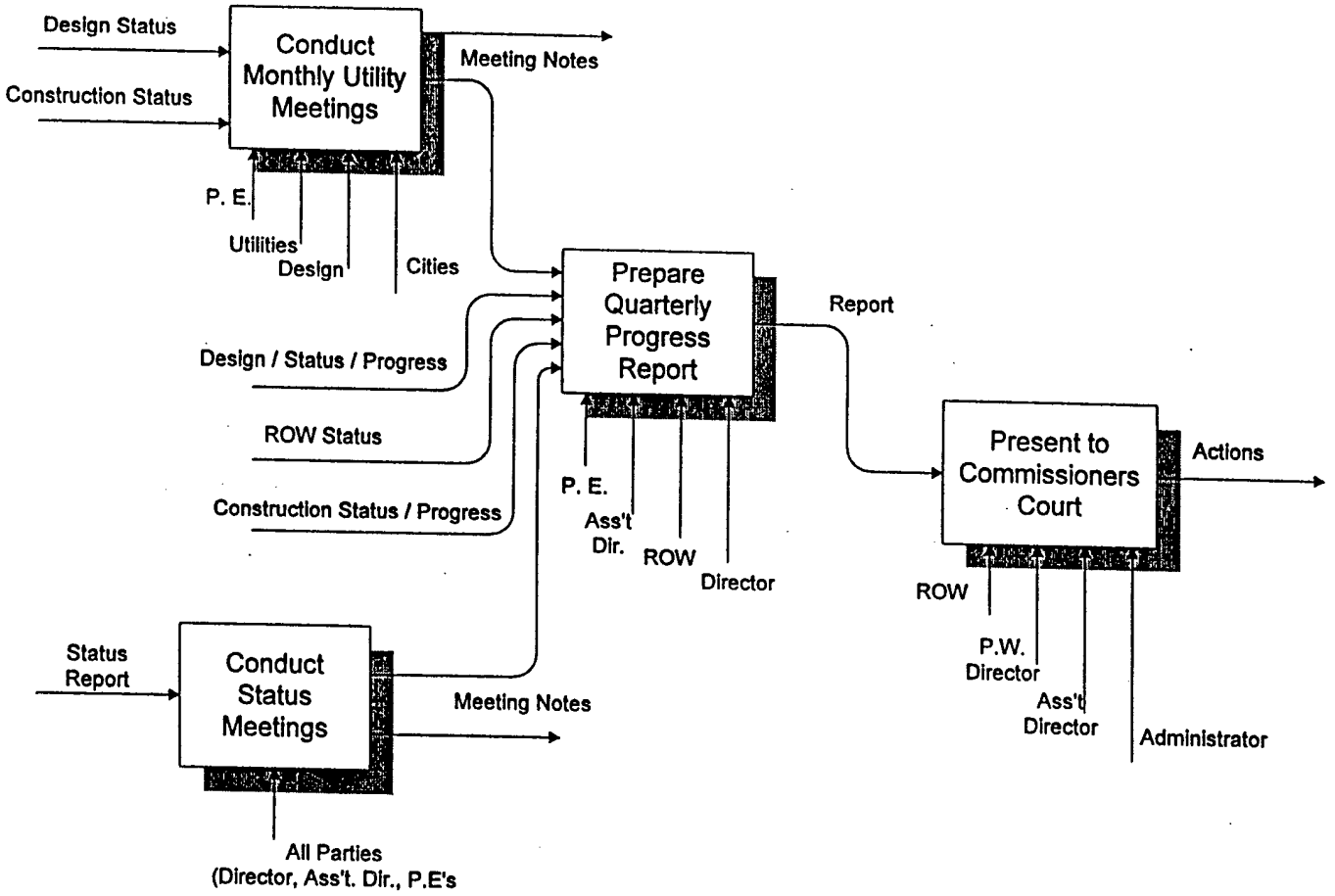


Project Management Activities During Post - Construction

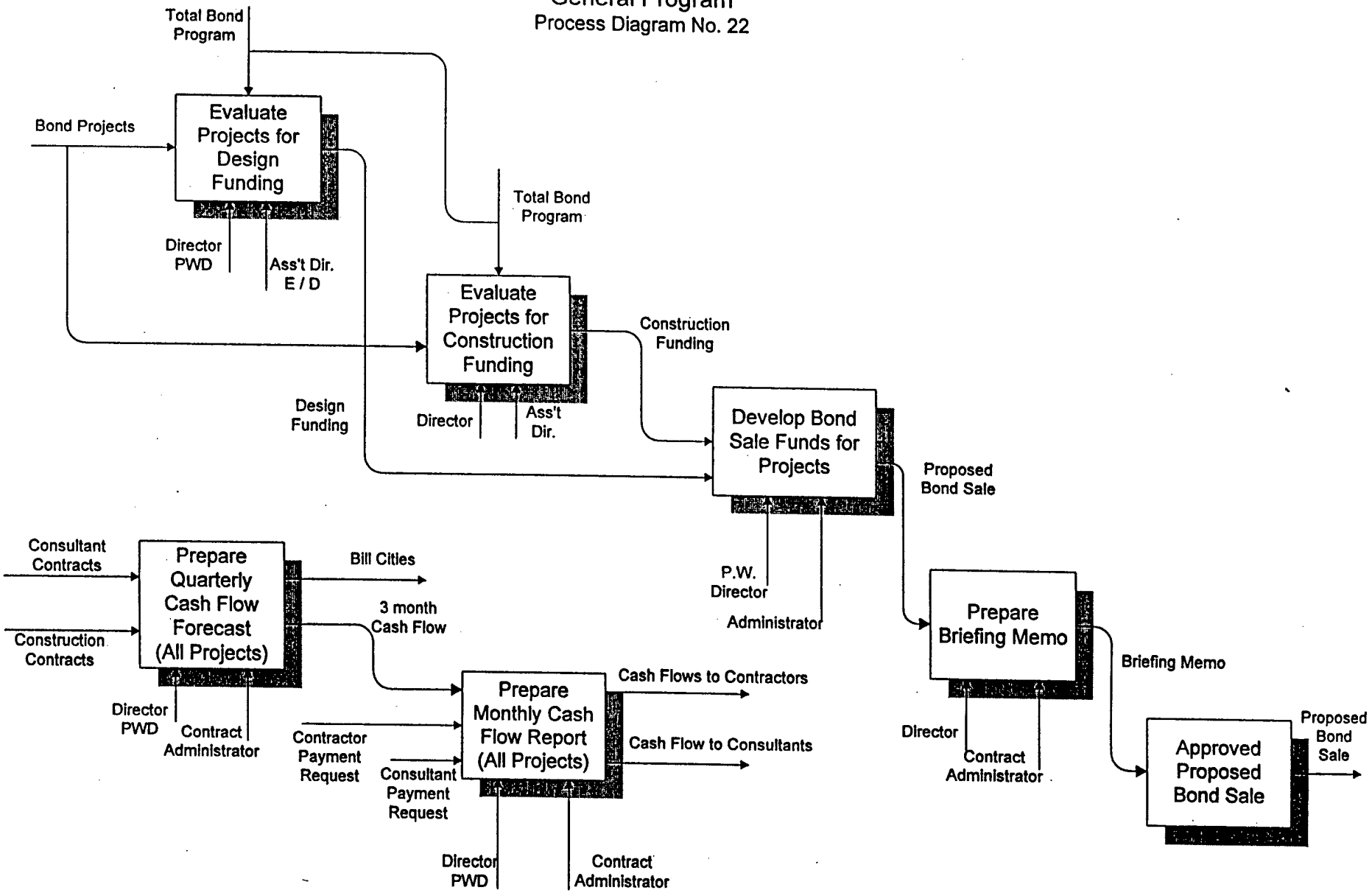
Process Diagram No. 20



Project Management Activities
General Program
Process Diagram No. 21



Project Management Activities
General Program
Process Diagram No. 22



APPENDIX B

CONFLICT MANAGEMENT STYLE QUESTIONNAIRES

Conflict Management Style

Supervisor Conflict

	Key:
1. When my supervisor asks me to do something which I feel opposed to, I will usually . . .	
a. Ask for his/her reasons, and then complete the assignment, even if I still have reservations.	*Smoothing (I)*
b. Express my concerns and listen to my supervisor's reasons, then make up my mind what to do.	*Problem-solving (II)*
c. Try to bring up my opinions, and see if we can meet halfway.	*Compromise (III)*
d. Keep to myself about my opinions.	*Withdrawal (IV)*
e. Stand up for my opinion even if I have to tell my supervisor that he/she is wrong.	*Forcing (V)*
2. As a member of a project team, if I am getting conflicting priorities from the team leader and my supervisor, I tend to . . .	
a. Work as hard as I can to please both, even if it means working on my personal time to finish both assignments.	*Smoothing (I)*
b. Explain the situation to each of them, and ask them how the three of us could work it out together.	*Problem-solving (II)*
c. Attempt to meet both of their requirements while still ensuring that I don't sacrifice my personal time.	*Compromise (III)*
d. Work on the priority that seems most important to me first, and hope that there is time left to work on the other.	*Withdrawal (IV)*
e. Tell them both that they need to communicate and get their priorities right before they make assignments.	*Forcing (V)*
3. It's 3:00, and my supervisor asks me to complete a priority task that I estimate will take me three hours. It needs to be completed by "first thing tomorrow morning," and I had plans to go out tonight. I am more likely to . . .	
c. Cancel my personal plans and get the job done without complaint.	*Smoothing (I)*
d. Tell my boss about my personal plans, and together work out a satisfactory plan that still meets his/her requirements.	*Problem-solving (II)*
e. Work on the project until I have to leave for my personal plans, and then come in early tomorrow morning to finish it by the time he/she needed it.	*Compromise (III)*
f. Work on the project until quitting time and then tell him/her tomorrow morning that I did as much as I could.	*Withdrawal (IV)*
g. Tell my supervisor that I've got plans, and he/she will have to give it to someone else.	*Forcing (V)*

Co-worker Conflict

Key:

1. If I hear that the designer of my project is criticizing all the field changes that I've implemented, I will usually . . .
   a. Tell myself that he/she is probably right, since it's sometimes easier to go along with the contractor's wishes than to get into arguments over every last change order. — *Smoothing (I)*
   b. Call the designer, and offer to work out some of the problems with him/her. — *Problem-solving (II)*
   c. Call the designer, and tell him to stop criticizing my field changes; that I'm just doing my job. — *Compromise (III)*
   d. Ignore the whole incident and not worry about what the design people are saying. — *Withdrawal (IV)*
   e. Let my supervisor know about the incident, and get him/her to tell the designer to stop criticizing my work. — *Forcing (V)*

2. When I have a conflict with one of my co-workers, I tend to . . .
   a. Let my co-worker have his/her way, in order to avoid hurting his/her feelings. — *Smoothing (I)*
   b. Try to find out all the issues in the conflict, and arrive at a mutual agreement. — *Problem-solving (II)*
   c. Try to work out a compromise solution. — *Compromise (III)*
   d. Leave the area and try to avoid him/her for awhile. — *Withdrawal (IV)*
   e. Stick up for my position, even if it means getting into a heated discussion. — *Forcing (V)*

3. If a co-worker asks me to review his/her change order, and I find it to be only marginally satisfactory, I am likely to . . .
   a. Tell him/her that it's fine. — *Smoothing (I)*
   b. Ask him/her what areas he/she thinks could use improvement, then offer my suggestions and assistance in improving the change order. — *Problem-solving (II)*
   c. Tell him/her that it's satisfactory, but could've improved in several areas. — *Compromise (III)*
   d. Leave the change order on his/her desk, with a note saying you've completed the review, but not offering any comment either way. — *Withdrawal (IV)*
   e. Tell him/her that it was marginal at best, and that he/she needs to put more attention into the change order. — *Forcing (V)*

Subordinate Conflict (for supervisors only)

1. If one of my engineers processes a change order very quickly, but without concern for quality, I am likely to . . .
   a. Praise him/her for completing it so quickly, but don't tell him/her that it was only marginally satisfactory. *Smoothing (I)*
   b. Ask for his/her opinion, show him/her areas for improvement, and then help him/her correct it. *Problem-solving (II)*
   c. Thank him/her for completing it so quickly, but telling him/her that he/she needs to slow down a little and pay more attention to details. *Compromise (III)*
   d. Avoid saying anything to him/her directly, but fix it before submitting it as complete. *Withdrawal (IV)*
   e. Make him/her do it over immediately *Forcing (V)*

2. If two members of my work group are involved in a conflict, I prefer to . . .
   a. Separate the two, and smooth over the differences. *Smoothing (I)*
   b. Sit down with both of them, discuss the issues involved, and help them work out a solution. *Problem-solving (II)*
   c. Ask for both sides of the story, and come up with a compromise solution for them. *Compromise (III)*
   d. Leave them alone and hope they will work out their differences on their own. *Withdrawal (IV)*
   e. Tell them to stop their childish behavior, listen to each side, and implement a solution to the problem. *Forcing (V)*

3. My subordinate comes up to me, complaining that a designer is criticizing his/her field changes back at Headquarters. I will usually . . .
   a. Call the designer's supervisor and apologize for your engineer's shortcomings, since it's pretty common to sometimes let the contractor have his way instead of forcing the issue. *Smoothing (I)*
   b. Call the designer's supervisor and ask him/her to explain their concerns, offering your assistance in working out solutions. *Problem-solving (II)*
   c. Call the designer's supervisor and ask him/her to stop criticizing the field work; that we're all doing the best we can. *Compromise (III)*
   d. Tell my subordinate not to worry about it, that the designers just have their heads in the clouds and aren't grounded in reality. *Withdrawal (IV)*
   e. Call the designer and tell him/her to stop criticizing your engineer, "or else." *Forcing (V)*

APPENDIX C

CONFLICT FREQUENCY AND INTENSITY RATING QUESTIONNAIRE

Intragroup Conflict

Conflict Frequency

Based on your experience, how frequently have you felt the following common sources of conflict between members of your department?

1. Conflict over project priorities
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

2. Conflict over administrative procedures
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

3. Conflict over technical opinions and performance trade-offs
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

4. Conflict over budget resources
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

5. Conflict over cost of project
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

6. Conflict over schedules and manpower
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

7. Personality conflict
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

Conflict Intensity

Based on your experience, how intense are (i.e., how severe are the impacts of) the following types of conflict between members of your department?

1. Conflict over project priorities
   VERY SEVERE IMPACT *(4)* QUITE SEVERE IMPACT *(3)* SOMEWHAT SEVERE IMPACT *(2)* SLIGHT IMPACT *(1)* NO IMPACT *(0)*

2. Conflict over administrative procedures
   VERY SEVERE IMPACT *(4)* QUITE SEVERE IMPACT *(3)* SOMEWHAT SEVERE IMPACT *(2)* SLIGHT IMPACT *(1)* NO IMPACT *(0)*

3. Conflict over technical opinions and performance trade-offs
   VERY SEVERE IMPACT *(4)* QUITE SEVERE IMPACT *(3)* SOMEWHAT SEVERE IMPACT *(2)* SLIGHT IMPACT *(1)* NO IMPACT *(0)*

4. Conflict over budget resources

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

5. Conflict over cost of project

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

6. Conflict over schedules and manpower

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

7. Personality conflict

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

Intergroup Conflict

Conflict Frequency

Based on your experience, how frequently have you felt the following common sources of conflict between the Design Department's and your department's engineers?

1. Conflict over project priorities
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

2. Conflict over administrative procedures
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

3. Conflict over technical opinions and performance trade-offs
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

4. Conflict over budget resources
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

5. Conflict over cost of project
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

6. Conflict over schedules and manpower
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

7. Personality conflict
   VERY OFTEN *(4)* FREQUENTLY *(3)* SOMETIMES *(2)* SELDOM *(1)* NEVER *(0)*

Conflict Intensity

Based on your experience, how intense are (i.e., how severe are the impacts of) the following types of conflict between the Design Department's and your department's engineers?

1. Conflict over project priorities

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

2. Conflict over administrative procedures

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

3. Conflict over technical opinions and performance trade-offs

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

4. Conflict over budget resources

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

5. Conflict over cost of project

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

6. Conflict over schedules and manpower

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*

7. Personality conflict

VERY SEVERE IMPACT *(4)*	QUITE SEVERE IMPACT *(3)*	SOMEWHAT SEVERE IMPACT *(2)*	SLIGHT IMPACT *(1)*	NO IMPACT *(0)*